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ECONOMIC MOLLUSCA OF ACADIA

BY W. F. GANONG.

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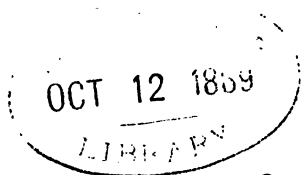
FROM

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The Anchor

It is particularly appropriate that papers of this character should be presented to such a society as ours. The highest function of a local Society of Natural History must be admitted to be the patronage and encouragement of local Natural History in its practical and educational, as well as scientific aspects. In this it has a claim for support and for sympathy upon government and people, which greater pretensions would not warrant.

The most valuable to man by far, of all the groups of Invertebrates, is that of the Mollusca. In all ages, in all parts of the world, savage and civilized men have utilized its members. The ancient refuse heaps of Europe show how old is the use of Molluscs as food; ethnologists have shown how wide-spread and old has been the use of shells for ornament, for money and for utensils of war and the home; and in more modern times, there have been found various other uses dependent upon the more numerous wants of advancing civilization. Unlike some other groups of animals, then, the Mollusca have been much observed by practical as well as scientific men; as in the useful plants, so among these, the useful forms are known to everybody.

Remembering these facts, we are not surprised to find, in works dealing with the exploration and early history of these provinces, that the edible Molluscs were the first Invertebrates to be noticed, excepting possibly some of the annoying Insects.

Jacques Cartier, the first explorer of the coast of Acadia who paid any attention to the animals and plants of the places he visited, does not mention any Invertebrates. It is not until we come to the works of Champlain and Lescarbot that we find references to the subject. Champlain's work, "*Les Voyages du Sieur de Champlain*," (Paris, 1613), records the earliest observations on the Mollusca of this region, but

Lescarbot speaks of the occurrence of Mussels at St. Croix Island, and referring to the natural productions of the country, says: "I would be forced to make an entire book if I should discourse on all the fishes which are common to the Brazilians, Floridians, Armouchiquois, Canadians and Souriquois. But I will restrain myself to two or three, after having said that at Port Royal there are great beds of Mussels, with which we filled our boats when sometimes we went to those places. There are also there, Scallops, (*Palourdes*),* twice as large as Oysters in size; also Cockles, which have never failed us." He makes a few other incidental references to this subject.

The next work to mention our Molluscs, appears to be the "Description Geographique et Historique des Costes de l'Amerique Septentrionale," and the "Historie Naturelle... de l'Amerique Septentrionale," by Nicholas Denys, in 1672. The latter work, especially, contains several references of considerable interest, though of not much scientific importance. He knew of the occurrence of the Oyster at several points on the North Shore, notably around George's Bay, at Malagash (?), Tatamagouche, Pictou, at Cocagne and the Bras D'or Lake. Other Shell-fish he frequently refers to, and mentions their abundance at several places, for instance, the region near Cape Sable, La Heve Harbor, George's Bay, near the mouth of Bras D'or Lakes, Tatamagouche, Miramichi, Bathurst, Port Daniel. He noticed Razor-fish (*Coutelieres*), near Cape Sable, and Scallops (*Conniffle*), at La Heve. His interesting description of the Squid and of the oyster-fishery, will be noticed under the sections on those animals.

We have not been able to find that anything on this subject worthy of note was written during the last century. Occasional references to the North Shore oyster-beds occur, but nothing further. Charlevoix, in his "Historie de la Nouvelle France," (1744), is said to have referred to the manner of fishing Oysters on the coast of Acadia, which was the same as

* Mr. J. H. Duvar tells the writer that the Acadian French of Prince Edward Island apply this word to the Quahog. It appears to have meant the Scallop to Lescarbot.

Denys describes, and the same as is used to-day. During the early part of this century, there were many works published, describing the three provinces and their resources, either for the encouragement of immigration or similar purposes. Many of these contain lists of the edible forms, with occasionally notes upon them. A fair sample of such lists is the following, taken from Robert Cooney's work, "History of Northern New Brunswick and Gaspé," published in Halifax, in 1832. Other Invertebrates are included, the Molluscs being italicized.

Blue crab.	<i>Sea clam.</i>
<i>Smooth cockle.</i>	<i>Shore clam.</i>
Lobster.	Star-fish.
<i>Muscle.</i>	Sea crab.
<i>Oyster.</i>	Soldier crab.
<i>Razor-fish.</i>	Sea urchin.
<i>Scollop.</i>	<i>Periwinkle.</i>

All of these will readily be recognized by the readers of the following pages.

In M. H. Perley's report on the Fisheries of New Brunswick (Fredericton, 1852), occur some really valuable though very brief notes, and in the Descriptive Catalogue of the Fishes of Nova Scotia, by Thomas F. Knight (Halifax, 1866), we find quite the best account of the economic Molluscs of these provinces which has appeared up to this time. On pages 43 to 54 of the latter is an account of the edible Molluscs of Nova Scotia, written by Mr. John Willis.* Many valuable notes are found also in the annual Fishery Reports of the Dominion. The splendid work recently issued by the United States government, "History of Useful Aquatic Animals" (Washington, 1884), gives a very good account of many of our Molluscs, but not with special reference to our waters. Other works, likely to be of interest in this connection, are mentioned in the list below.

A complete discussion of the economics of the Mollusca, in

*Mr. Knight says that this work by Mr. Willis, to which was appended a complete list of the Molluscs of Nova Scotia, had already been published in a colonial periodical. I have been unable to find, by careful inquiries, what that periodical was. I would be deeply grateful to any one who could give me this information.—W. F. G.

other words, of their relations to man's immediate interests, obviously includes a consideration of the injurious as well as of the beneficial forms. In the case of both of these, there is possible quite a natural division into those which are directly, and those which are indirectly, of injury or benefit, and this classification will be followed in this paper.

Of the direct uses to man of the Mollusca, the most important by far is that of food. The other uses must vary in importance with different ages, different localities, or different conditions of civilization. For our purposes we may consider the relative order to be as follows:

- (1) Use as food for man.
- (2) As bait in the fisheries.
- (3) As fertilizers for land.
- (4) For ornaments, including the production of pearl.
- (5) For money.
- (6) For the making of dyes.
- (7) For dishes and many minor uses.

The most important of all food-molluscs is, of course, the Oyster. It is found in nearly all parts of the world except in the coldest seas, has been used from the remotest antiquity and is one of the most popular food-substances known. Many people have claimed that ours, of Acadia, are the best that are found in the world, and this much appears certain, that if not the best, they are among the best. Next in importance with us comes the soft-shell Clam, then the Scallop, the Quahog, Periwinkle, Razor-fish, Mussel, Whelk, Squid and one or two others. In Europe the Mussel takes the place of the Clam and the Periwinkle, and stands before it and just after the Oyster. It is most remarkable that Molluscs esteemed in Europe should be neglected in Canada, and *vice versa*. Though our common Clam is abundant in the former country, it is never used either for food or bait, while the Mussel and Whelk, highly esteemed and of great value there, are rarely utilized by our people. No doubt the greater variety of cheap food within reach of our poorer classes has something to do with this, for it is chiefly by the lower classes that those Molluscs are used in Europe.

The following table, compiled from the work of Dr. Atwater, will show the respective nutritive values of several of our Molluscs, that of beefsteak and salmon being added for the sake of comparison.

	Per cent. of water.	Per cent. of nutrients.	Protein.	Fats.	Carbo- hydrates.	Mineral matters.
Beefsteak,.....	60.	40.	19.	20.		1.
Salmon,.....	63.2	36.8	22.6	12.9		1.3
Oyster (O. Vir- giniana.)	87.3	12.7	6.0	1.2	3.5	2.0
Clam (Mya arenaria.)	85.9	14.1	8.5	1.0	2.0	2.6
Quahog (Venus mercenaria.)	86.2	13.8	6.6	0.4	4.2	2.6
Mussel (Mytilus edulis.)	84.2	15.8	8.7	1.1	4.1	1.9
Scallop (Pecten irradians.)	80.3	19.7	14.4	0.2	3.4	1.4

Other investigators have obtained results somewhat different from these, which give to the Oyster a higher nutritive value. Its value as food depends very largely upon conditions not shown by the table, such as easy digestibility and the like. For these reasons it is good for invalids and is frequently prescribed by physicians. It will be noticed that the Mussel has a higher nutritive value than the Clam, and that in some respects both are better than the Oyster.

Important as food-molluscs are to us, they were very much more so to the Indians who preceded us in Acadia. Everywhere on our coast, where Molluscs are abundant, we find heaps of shells which were thrown from the doors of the wigwams when their contents had been removed. These kept accumulating for ages and in places are acres in extent and two or three feet in thickness. They consist, upon the southern coast, chiefly of Clam shells, but also Mussels, Whelks, Periwinkles, Limpets and the Scallop have been found, some of these perhaps carried in accidentally. Mingled with them are the bones of the principal Mammals of the region, and household or hunting implements, doubtless lost by their owners. These camping-places were occupied chiefly in the

spring and early summer when the land game was breeding and in poor condition, and life in the woods nearly intolerable on account of the insects. Indeed we have historical evidence that such was the case. Champlain tells us, "when they (the Indians) do not hunt, they live on a shell-fish called the cockle," the latter, as pointed out on a previous page, being the Clam. Denys, speaking of the region about George's Bay and Gut of Canso, tells us there was there "an abundance of Shell-fish of all kinds good to eat, which are the most important means of subsistence of the savages during the spring." There is, no doubt, much of interest to antiquarians, and something to naturalists, to be learned from a study of these shell-heaps. Those of the north shore have been investigated by Rev. Dr. Patterson, though not, as he tells the writer, with reference to their shells, while those of the southern coast have been explored by Mr. G. F. Matthew and others, references to which will be found below.*

For bait in the fisheries, the Squid and the Clam are of most importance to us. The latter has been used for a very long time, the former for not many years. It seems most remarkable that the Mussel, the same species as that of Europe, and as abundant, should be totally neglected for this purpose. In Europe it is considered the best of baits; it is easier to obtain than the Clam and it should be tried by our fishermen. The Whelks and other common Molluscs would undoubtedly be good for this purpose, but are not abundant enough to replace the omnipresent Mussel.

With us, the so-called mussel-mud is the most important fertilizer which the sea yields. This consists chiefly, however, of oyster-shells, and its value to Prince Edward Island is considered by Mr. J. H. Duvar to be as great as that of the living Oysters. We believe that the farmers of the Southern and Atlantic coasts would find a rich fertilizer in the masses of

*Discoveries at a Village of the Stone Age at Bocabec, N.B. By G. F. Matthew. Bull. N. B. Natural History Society, No. III., 1884, pp. 6-29.

Notes on Certain Aboriginal Shell Mounds on the Coast of New Brunswick and of New England. By S. F. Baird, Proc. U. S. National Museum. Vol. IV., 1881, pp. 292-297.

Also see Trans. N. S. Institute. Vol. I., Part II., 1864, pp. 94-99.

mud underlying the mussel-beds. In time the Mussels themselves are sure to become valuable, and certain beds should be left undisturbed. The Squid has been to some extent used for this purpose, but lately it has become too valuable as a bait to be so employed.

The shells of but few of our Molluscs are available for purposes of ornamentation. Most shells of the Temperate Zone are plain and dull in comparison with the brilliantly colored and beautifully sculptured forms of the tropic seas. Hence a review of the subject as far as regards our waters would be very short in comparison with that of the world at large. Savage and civilized man have alike delighted to use them for personal and household decoration. Some of our Whelks or Spindle-shells are frequently seen as ornaments for mantels in fishermen's houses, and as borders for flower-beds in their gardens. Mussel-shells and the Cockle (*Cardium*) are made into ornamental dishes, pin-cushions and the like. The valves of Scallops, particularly of our great *Pecten tenuicostatus*, and the Beach Clam (*Macra solidissima*) give a good surface for painting on, and are frequently thus utilized. No doubt our *Trochus occidentalis* and species of *Margarita* could be used for many minor purposes if they could be obtained in sufficient numbers; they are as beautiful as most of the shells made into shell boxes and the like. The Indians of America used wampum as an ornament as well as for money; the Indians of Acadia appeared to have employed it more for the former purpose than the latter. The subject will be further considered below.

By far the most important of ornaments yielded by Molluscs are pearls. The best, as everybody knows, come from the Persian Gulf and the coasts of Ceylon and Central America, and are found in the pearl oyster. Several of our Molluscs yield bodies, which, though pearly in their nature and mode of formation, yet lack the lustre of true pearls. Such occur in the Horse-mussel, Edible Mussel, and even in Quahogs, Clams and Oysters, of which the first two have the nearest true pearls in appearance. Those of the Edible Mussel have had some commercial value in England. In the Mussels of our fresh

water streams, however, we have pearls produced, of which the value will, no doubt, astonish many of the readers of this paper. The species producing them have, unfortunately, not been fully worked out, but they belong for the most part to the genus *Margaritana*. Pearls from fresh-water Mussels are found in Europe, and were known from very early times. Those from our River-mussels have sometimes great beauty; as much as is known of their value will be found in a subsequent part of this paper.

In many of the East India Islands, the only money which can be used in traffic, consists of the shells of the Cowry (*Cypræa monetum*). Traders are obliged to provide themselves with a store of it beforehand, and formerly many tons were annually collected and sent to England for the use of traders. This is the most conspicuous example of the use of shells as money, which occurs to us, but many other savage tribes utilized shells for this purpose. Indians of the west coast of America used species of *Haliotis* or Ear-shells, and other tribes, strings of *Dentalium* or Tooth-shells. Among the east coast Indians and those of the interior, wampum was the great medium of exchange and was a true currency. White wampum was made from the central column of the shell of two species of Conch (*Sycotypus canaliculatus*, and *Fulgur carica*); purple and the more valuable wampum, was made from the purple part of the shell of the Quahog or Round Clam. These were made into beads, not more than half an inch long, which were strung on threads, the threads being sometimes fastened together side by side to form belts. This was very extensively used by the east coast Indians in their traffic with one another and with the whites. In Acadia it appears to have been used more for ornamental and ceremonial purposes than for money. The Passamaquoddies had "Wampum Records" as Mr. Leland tells us in his "Algonquin Legends." Les-carbot, in his "History of New France, (1609, book VI., chap. XII.), has left us a most interesting account of its value to the Micmacs, which, as it has apparently escaped the notice of the writers on this subject, is here given in full.

"The Brazilians, Floridians and Armouchiquois, [*i. e.*, the

Indians from Kennebec to Cape Cod,] make carcanets and bracelets (called *bou-re* in Brazil, and *matachiaz* by our Indians), from the shells of those great sea-shells which are called VIGNOLS and are like unto snails, [*i. e.*, the large Conchs, *Sycotypus* and *Fulgur*] which they break and gather up in a thousand pieces, then polish them upon a (hot)* stone, so that they make them very small, and when they have pierced them, they make beads, like to those which we call porcelain. Among these beads they mingle alternately other beads, as black as the others I have spoken of are white, made of jet or of certain hard or black woods which resemble it, [meaning probably dark purple wampum,] which they polish and make as small as they wish, and this has a good grace.

“And if things are to be esteemed for their fashion, as we see exemplified in our merchandise, these collars, scarfs and bracelets of VIGNOLS or porcelain, are more valuable than pearls (notwithstanding no one will believe me in this), for they esteem them more than pearl, gold or silver. As with us, so in this land do the women deck themselves with such things, and will make a dozen turns of it around the neck, hanging upon the breast, and around the wrists and below the elbow. They also hang long chains in their ears, which hang down even as low as their shoulders. If the men wear any it is only some young one who is in love. But at Port Royal and thereabouts, and towards Newfoundland, and at Tadousac, where there are neither pearls nor VIGNOLS, the maids and women make *matachiaz* from the quills or bristles of the porcupine, which they dye with black, white and red colors, as vivid as possible: for our scarlet has no better luster than their red dye. But they prize much more the *matachiaz* which comes to them from the land of the Armouchiquois and buy it at a very high price. And since they can get but a little of it, because of the war which these two nations [*i. e.*, the Micmacs and the Armouchiquois,] have always between each other, there is brought to them from France *matachiaz* made of little tubes of glass mixed with tin or lead, which are

*The word used is *grez*, which is translated by Erondelles, “hot stone.”

traded to them by the fathom-measure for want of an ell-measure." As Lescarbot points out, the shells from which the white wampum was commonly made, do not occur upon the shores of Acadia, and the Acadian Indians do not appear to have manufactured the purple wampum, though the material for it was abundant on the North Shore. Denys mentions that they wore among their ornaments, "white and violet porcelain," and goes on to say,—“they make of it also pendants for the ears, which they have pierced in two or three places. This porcelain is nothing else than the teeth (dents) of a certain fish which is taken by the savages in New England, and which is very rare there and at this time is very much valued among them; that which is common now, has each grain of the length of half a finger's breadth.”

Prof. Bailey mentions the occurrence of wampum in an Indian grave on the Tobique, though made, as he thinks, from the shells of Fresh-water Mussels.

The most noted dyeing material of ancient or modern times, that which gave the Tyrian Purple, was obtained from Molluscs which are closely allied to our Purple-shell (*Purpura lapillus*). The latter shell, exceedingly abundant on our shores, itself yields an unchangeable rich crimson dye, which can easily be obtained. The expense of collecting it, however, is much too great to allow it to be of any commercial value. The Long Whelk (*Buccinum undatum*) also is said to yield a dye.

Of minor uses for shells, there are very many. Several of the large bivalves, notably the Scallops and the great Sea-clam (*Macra*) are used by fishermen's wives and others for dishes. The Acadian Indians made their pottery in part from powdered shells, and no doubt made much use of them as household utensils. Oyster shells are frequently used for road-making in the United States, and of course could be so utilized with us. They are said to be among the best of materials for this purpose. In the United States, shells of various kinds, chiefly Oyster and Scallop, are strewn upon the oyster-beds to give a clean firm surface for the young to attach themselves to. Oyster-shells are also ground up to be

given to poultry. From the Squids a kind of oil can be made, though we believe it has little value commercially.

Of the indirectly useful Molluscs, doubtless the most important to man, are those which serve as food for the food-fishes. A list of the Molluscs known to inhabit New England waters, which are eaten by Cod, Haddock and other large fish, is given in the "History of Useful Aquatic Animals of the United States," pp. 693, 694 and 703. The majority of the forms there mentioned occur in the waters of Acadia. It may not be amiss to state here, that the stomachs of fishes are fine hunting-ground for the conchologist, many species being found in them, which are rare, or inaccessible in other ways.

Indirectly also those Molluscs are beneficial to man, which, by forming great tough beds, as the Edible Mussels do, protect easily eroded sea-coasts from being washed away; which bore into and ultimately remove reefs and wrecks which are a bar to safe navigation, as does the *Teredo* and its allies; and those which are beneficial to the oyster industries, the most important of which is the Periwinkle (*Littorina litorea*), and some others.

Among the injurious Mollusca, the Ship-worms must take first place. Species of *Teredo* are found all over the world, but are most destructive in warm waters. They bore into and destroy any kind of timber that is under the surface in pure salt water. Hence, wharves, ships, buoys, breakwaters, are all attacked, and naturalists and engineers have been put to their wits' ends to study their habits and find a remedy. In the following pages will be found some account of their results. In Acadian waters we have some three or four species; they are most troublesome upon the North Shore and Cape Breton coast, where the warmer summer temperature affords better conditions for the development of the young, than does the much colder water of the Atlantic and Bay of Fundy shores. Those Molluscs which bore into stone (*Pholas* and allies) have never done any damage upon our shores.

Among those which may be called indirectly injurious, are those which are destructive to oyster-beds. In American waters there are a number of these, the chief of which is the

Drill (*Buccinum cinereum*), which is present upon our own North Shore. This Mollusc does great damage in the United States, but little on our oyster-beds. Indeed, as elsewhere pointed out, the chief oyster enemies of the United States are either absent altogether from our waters, or do but little damage—a circumstance of great advantage to future culturists. Other indirectly injurious Molluscs are the Squids, which destroy large number of herring and other small fish. It will of course be evident that an animal may be, at different times and in different ways, both beneficial and injurious.

Is it not remarkable that the first attempt at mollusc-culture in Acadian waters was contemporaneous with its first settlement in 1604? It was so, though in a rudimentary form. Lescarbot, in describing DeMont's settlement at St. Croix Island (Dochet Island of to-day), says: "There is also a little chapel built after the fashion of the savages, at the foot of which there is such a store of mussels as is wonderful, which may be gathered at low tide, but they are small. I believe that Monsieur DeMont's people did not forget to choose and take the biggest and left there but the small ones to grow and increase." Thus was one of the axioms of modern mollusc-culture observed by the first settlers on the shores of Acadia. Nothing more, even of this simple kind, seems to have been done until the experiments of Hon. Mr. MacFarlane, in Nova Scotia, and Hon. Mr. Pope, in Prince Edward Island, to be spoken of in connection with the Oyster.

The need of mollusc-culture for the present time in Acadia, resolves itself into the need of oyster-culture. No other Mollusc on our shores is fished to anywhere near its limit of natural productiveness, much less beyond it. But as our food-molluscs came to be extensively used, as they ultimately must, regulations of the fishery should be enforced from the first, and not after the supply verges on exhaustion. In the case of the Oyster, there is need of immediate and vigorous government interference, not only for the protection of the present beds, but for the encouragement of the planting of new ones. To culturists there must be given not only

an absolute right to the products of their labor and protection from trespassers, but even, if necessary, positive encouragement in the way of bounties, until Oyster-culture shall become an established industry of the Dominion. Canada does not now produce more than a fraction of the Oysters she uses; it is soon to become a question of deriving the greater part of her supply from cultivated beds in the United States or from cultivated beds in Canada, for the natural beds of the United States are rapidly becoming exhausted, and attention is being directed towards culture.

Something should be said here as to the distribution of Molluscs in our waters. It will be noticed by those who read the following pages, that many forms are spoken of which occur in the Gulf of St. Lawrence and not elsewhere north of Cape Cod; others occur in the Bay of Fundy, the distribution of which is circumpolar or arctic. These are two among very many facts which indicate a curious distribution of animal life in Acadian waters. In the southern part of the Gulf, all along the North Shore of New Brunswick and Nova Scotia and all around the coast of Prince Edward Island and Cape Breton, occur animals of species identical with those living to the south of Cape Cod, and in most cases they do not occur in numbers between those localities. The Oyster, Quahog, Drill (*Urosalpinx*), Plicated Mussel, are all examples of this, and many others might be mentioned which do not fall within the limits of this paper. In the Bay of Fundy and on the coast of Nova Scotia, south of Chebucto Bay, on the other hand, the forms are decidedly northern, the uniformly cold water of that region not allowing of the development of the young of such southern forms as can thrive in the Gulf. In the latter, the shallow waters, little disturbed by tides, can become very warm during the summer, and favorable conditions thus being provided for the young, the adults survive 72 them in spite of the cold of winter. For the origin of this condition of affairs we must look to geological causes, the discussion of which is not in place here. The substance of it is, that in times recent geologically (certainly post-glacial), an

elevation of the land in this region threw the Labrador current off from the coast and allowed the water inside the Banks, then near the surface, to become warmed up in summer, as it is to-day in the Gulf of St. Lawrence. These forms then crept northward and all the coast from Virginia to Newfoundland was occupied by them. The land is now sinking; cold currents are coming back to our shores and the southern animals cannot hold their own against the northern, which are better fitted for the new conditions. It is probable that ultimately all of these southern forms will become extinct in the Gulf, but the time is so remote that the practical man need not take it into his calculations.

It should be hardly necessary to call attention to the fact here, that there is yet very much to be learned about the distribution of Molluscs and other animals upon our shores; about their habits, their relations to other animals, their usefulness and noxiousness to man. Even in the matter of their value and palatableness as food there is much need of information. There is an abundance of work for every observer to do, and teachers who interest themselves and their pupils in such subjects will be repaid many fold, not only by the facts observed and training acquired, but by their further initiation into the spirit of nature and their refreshment by the pure air of new fields, both figurative and literal.

In the following list, the nomenclature adopted is not in all cases that of the latest authorities, though such names are always given in the synonymy. The scientific name given first is usually that of Binney's Edition of Gould's *Invertebrata of Massachusetts*, though in certain instances where the latter is clearly erroneous, as in the Cephalopods, those of other writers are followed. The work mentioned is the only one extant which gives an account of our Mollusca, and, unfortunately, is rare and expensive, though it is to be found in most scientific libraries. Those who wish scientific descriptions and figures should turn to it, and there they will find references to other works of importance. The list of works given below includes only those consulted in the preparation of this paper.

An interesting part of the present subject is that of local names for our Mollusca. As soon as a species comes to be much used, it requires a special distinctive name, and such the fishermen generally give it. As so few of our own Molluscs are utilized for any purpose, very few of them have common names, and in such cases we have felt at liberty to adopt for those lacking them, the best of those by which they are known to English fishermen. The writer would be very thankful for any information which could be given him as to local names applied to Mollusca in any part of these provinces.

We believe no explanation is needed of the use of the word Acadia throughout this paper. The three maritime provinces are, zoologically, botanically and geologically one, and a term by which they can be collectively designated is a necessity in scientific if not other writing. Several writers on the natural history of the region have employed the word Acadia, and what more appropriate name can ever be used?

WORKS OF REFERENCE.

Descriptive Catalogue of the Fishes of Nova Scotia. By THOMAS F. KNIGHT. *Halifax*, 1866, 8vo, 54 pp. Pp. 43 to 54 treat of "Edible Mollusca of Nova Scotia."

[This part dealing with Mollusca is in reality by Willis, for Mr. Knight says: "The author is indebted to J. R. Willis, Esq., of Halifax, for the following ample description of our Edible Mollusca, which has already been published in a colonial periodical." Can any of our readers tell us what this periodical was, and its date? We have not been able to find any trace of it.]

Mollusca of Nova Scotia. By J. MATTHEW JONES. *Proc. and Trans. of Nova Scotian Institute of Nat. Science*. Vol. IV., Part III., 1877, pp. 321-330.

Zur Fauna von Neu-Schotland (Nova Scotia) und Newfoundland. By T. A. VERKRÜZEN. *Jahr. der Deutschen Malak. Gesell.* Vol. V., 1878, pp. 208-230.

- The Marine Mollusca of New Brunswick. By W. F. GANONG. *Bull. Nat. Hist. Soc. of N. B., No. VI.*, 1887, pp. 17-61.
- Report on the Invertebrata of Massachusetts. By A. A. GOULD. 2d edition, edited by W. G. BINNEY. *Boston*, 1870, 8vo, viii.+524 pp., 12 plates and very many woodcuts.
- Report on the Invertebrate Animals of Vineyard Sound, etc. By A. E. VERRILL. *Rep. U. S. Fish Commission for 1871-72*, pp. 295-778, 38 plates.
- British Conchology. By J. GWYN JEFFREYS. 5 vols. *London*, 1862-69.
- Edible Molluscs of Great Britain and Ireland, with Receipts for Cooking them. By LOVELL REEVE. *London*, 8vo. pp. 210, date (?) [Not seen by the writer].
- Commercial Products of the Sea. By P. L. SIMMONDS. *New York*, 1879, 8vo, viii.+484 pp., woodcuts.
- Harvest of the Sea. By J. G. BERTRAM. 2d ed. *London*. 1869.
- Contributions to the Knowledge of the Chemical Composition and Nutritive Values of American Food-fishes and Invertebrates. By W. O. ATWATER. *Rep. U. S. Fish Commission for 1883*, pp. 433-499.
- A Review of the Fishing Industries of the United States. By G. BROWN GOODE. *London*, 1883, 8vo, 84 pp. (Fishery Exhibition Literature, Vol VI.)
- Catalogue of the Economic Mollusca, etc., exhibited by the United States National Museum at the International Fisheries Exhibition. By Lieut. FRANCIS WINSLOW. *Bull. U. S. National Museum, No. 27*. 1884, pp. 185-270. Also a list by G. BROWN GOODE, in *Bull. No. 14*, 1879, pp. 251-259.
- Fisheries and Fishery Industries of the United States. By G. BROWN GOODE and others. Section I. History of Useful Aquatic Animals. Section V., Vol. II. The Oyster, Scallop, Clam, Mussel and Abalone Industries. *Washington*, 4°, 1884, and later.
- Fisheries Exhibition Literature, *London*, 1883-84. 16 vols.

I wish here also, to return a grateful acknowledgment to those gentlemen whose kindness to me in replying to my enquiries has added much to the completeness of this paper. To Mr. John Tilton, Deputy Minister of Fisheries, for copies of Fishery Reports; to Mr. J. H. Duvar, Inspector of Fisheries in Prince Edward Island, and my friend Mr. S. W. Kain, of St. John, for much information I am particularly indebted. Mr. H. Piers, of Halifax, Mr. J. A. Turner, of St. John, and Mr. John Sharp of Summerside, have also patiently answered my troublesome enquiries, for which I am sincerely thankful to them. The Micmac names of Molluscs have been taken verbatim from Dr. Silas T. Rand's "First Reading Book in the Micmac Language." The Milicete, or, more properly, Passamaquoddy, names have for the most part been given me by Mr. H. Lyle, of St. Stephen. Figures 3, 5 to 17, 19 and 21 are from Binney's Gould. Figure 4 is reduced from the same. Figures 18, 20, 22 are from Verrill's Report on Invertebrates of Vineyard Sound. Figures 1 and 2 are reduced from the latter's Monograph on Cephalopods of North-eastern Coast of America. All have been reproduced by the Helio-type Company of Boston.

SECTION II. A LIST OF THOSE MOLLUSCS OF THE WATERS OF
ACADIA WHICH ARE USEFUL OR INJURIOUS
TO MAN.

ANALYSIS.

A. USEFUL MOLLUSCA.

(a) Directly useful.

1. As food.

See *Ostrea Virginiana*
Mya arenaria.
Mya truncata.
Pecten tenuicostatus.
Pecten Islandicus.
Pecten irradians.
Venus mercenaria.
Mytilus edulis.
Modiola modiolus.
Solen ensis.
Macra solidissima.
Macra ovalis.
Cyprina Islandica.
Zirphæa crispata.
Cardium Islandicum.
Littorina litorea.
Lunatia heros.
Buccinum undatum.
Fusus Islandicus.
Fusus decemcostatus.

2. As bait in the fisheries. See *Ommastrephes illecebrosa*.

Loligo Pealei.
Mya arenaria.
Mya truncata.
Mytilus edulis.
Macra solidissima.
Macra ovalis.
Buccinum undatum.
Purpura lapillus.

3. As fertilizers. See *Ostrea Virginiana*.
 Mytilus edulis.
 Modiola plicatula.
 Ommastrephes illecebrosa.
 Loligo Pealei.
4. For ornaments, including pearl.
 See *Margaritana*.
 Venus mercenaria.
 Mytilus edulis.
 Modiola modiolus.
 Cardium Islandicum.
 Pecten tenuicostatus.
 Mactra solidissima.
 Buccinum undatum.
 Fusus Islandicus.
 Fusus decemcostatus.
5. For money. See *Venus mercenaria*.
6. For dyes. See *Purpura lapillus*.
 Buccinum undatum.
7. For dishes and minor uses.
 See *Ostrea Virginiana*.
 Pecten tenuicostatus.
 Mactra solidissima.
 Mytilus edulis.

(b) Indirectly useful.

- (1) As food for fishes. See Introduction of this paper, p. 15.
- (2) Protection of coasts from erosion, etc.
 See *Mytilus edulis*.
 Modiola modiolus.
- (3) Removal of wrecks and obstructions to navigation.
 See *Teredo navalis*.
- (4) Of value to oyster beds. See *Littorina littorea*.

B. INJURIOUS MOLLUSCA.

(a) Directly injurious.

1. Destructive to sub-marine timber.
 See *Teredo navalis*.
 Teredo norvegica.
 Teredo dilatata.
 Xylophaga dorsalis.

2. Molluscs occasionally poisonous.

See *Mytilus edulis*.
Modiola modiolus.
Pecten tenuicostatus.

(b) Indirectly injurious.

1. Destructive to oyster beds.

See *Buccinum cinereum*.
Purpura lapillus.
Lunatia heros.
Mytilus edulis.

2. Destructive to young fish.

See *Ommastrephes illecebrosa*.
Loligo Pealei.

Class CEPHALOPODA.

1. *Ommastrephes illecebrosa* (Lesueur) Verrill.

Ommastrephes sagittatus Ferussac.

[Verrill thinks that this species is not identical with the European *O. Sagittatus*. The *Loligo Bartramii* of Stimpson, in his Synopsis of the Marine Invertebrata of Grand Manan is this species.]

Squid, Short-finned Squid, Sea-arrow, Flying Calamary.

Micmac, Sedaasoo-k. *Passamaquoddy*, Sah tah sis.
Acadian French, Alcorne.

[*Ommastrephes*, turning its eyes; *illecebrosa*, very attractive.]

DISTRIBUTION. (a) *General*;—Rhode Island to Cumberland Gulf.

(b) *In Acadia*;—Abundant around the entire coast of the three Provinces. Verrill says it is "abundant from Cape Cod to Newfoundland."

HABITS. The Squid is easily recognized and is one of the best known of our Molluscs. It is the most highly organized of the group, and in its appearance and most of its habits, resembles a fish rather than what it really is.

The body is cylindrical, tapering to a point at the posterior end, and in front bears a head which has ten arms arranged in a ring around the mouth. These arms bear sucking disks on their inner sides, in the two longer near their extremities only, and in the other eight quite to their bases. The mouth is armed with a stout horny beak similar to that of a parrot. The large and very bright eyes are on diametrically opposite sides of the head; they have lids and a round pupil. The neck is well marked, sharply separating the head from the body. On the under side of the latter, projecting forward, is a stout process with an opening at its apex which might be mistaken for a mouth. It is the opening of the tube or siphon by which water is drawn into and expelled from a sac inside the body, this being, as will be explained below, its locomotive apparatus. At the posterior end, attached on the dorsal side, is the broad caudal fin which extends a little more than a third (about two-fifths) of the length of the body proper. It extends out laterally on each side of the latter and is shaped like the quadrant of a circle, the arc being to the front and the two radii sloping to the extreme posterior end. An average specimen is fourteen inches in extreme length, the body proper being eight inches; length of fin about three inches; body one and one-half inches in diameter.

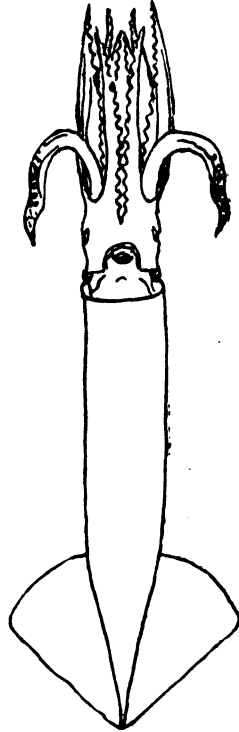


FIG. 1.—*Ommastrephes illecebrosus*. Young male, three-sevenths of natural size.

In the interior on the back of the animal, and running the entire length of the body, is a translucent, horny pen-shaped structure, called the "pen." This is in reality the shell, reduced and carried inward instead of covering the outside of the animal.

The color is variable in the extreme. The ground color is pale bluish-white, and in the skin are many chromatophores, or cells containing colored pigments, any set of which can be expanded or contracted at the will of the animal. It is thus that the rapid changes of color are caused—red, orange and brown seeming to predominate in this species. Prof. Verrill says:—"The colors change constantly, when

living or recently dead, by means of the continual contraction and dilation of the chromatophores. The different tints pass over the surface like blushes."

The Squid, so well named Sea-arrow, is extremely swift and graceful in its movements. It swims by the forcible ejection of water from its siphon, the reaction driving the animal backward with great velocity. The arms pressed close together, trail out behind, and the fin, used to balance or steady the body when the animal is moving slowly, is wound tightly around it when it goes swiftly. But the siphon can be pointed backward and the animal go forward, when necessary, though it does so much less easily than it can go backward. It lives upon young herring or mackerel, following the schools in to the coast. It takes these fish by darting in among them, turning suddenly to one side, and seizing one which it kills by a bite in the back of the neck. Squid move in schools, and are most active at night. They often come ashore in large numbers, on account, no doubt of their running backwards. When much alarmed they discharge with the water from the siphon an inky fluid which blackens the water around. It is eaten by many fishes.

Nothing is as yet known of its breeding habits. Professor Verrill, arguing from the structure of the reproductive parts, believes it will be found that the eggs are cast free into the ocean, and float singly or in masses on the surface.

ECONOMICS. Fifteen or twenty years ago the Squid would hardly have found a place in a paper of this character. Its great, almost its only, use is as a bait for cod and other large fish, and it is only of late years that it has come to be so extensively used. In Newfoundland, especially, it is taken in enormous quantities, both for the use of the native fishermen and for sale to those of the United States. It is the chief reliance of the latter for their fishing on the Grand Banks; for though they bring salted clams or other bait, Squid are always preferred. They are mostly caught by native fishermen, who sell them for from twenty-five to forty-five cents per hundred. The French have vessels specially devoted to taking and delivering it. There are no statistics to show the extent to which it is used; but one writer states that the number annually used by United States vessels alone would "be reckoned high in the tens of millions." Mr. Ingersoll estimates that five hundred vessels and boats are annually engaged in taking Squid for bait. In the United States it is at present rarely or not at all taken for this purpose.

In Canada it is fast assuming great importance, as the following table will show. They are officially considered to be worth \$4.00 per barrel, though in certain instances much higher prices are quoted. To find the number of barrels divide the value by four.

VALUE OF SQUID TAKEN IN THE MARITIME PROVINCES FROM 1881 TO 1887.

	1881.	1882.	1883.	1884.	1885.	1886.	1887.
New Brunsw'k	\$ 500	\$ 208	\$ 1,972	\$ 1,392	\$ 2,256	\$ 2,816	
Nova Scotia...	\$9,600	13,200	17,464	10,732	12,556	17,576	121,280
Total,	\$9,600	\$13,700	\$17,672	\$12,704	\$13,948	\$19,832	\$124,096

Prince Edward Island sends no returns. In New Brunswick they are caught chiefly in Charlotte and Gloucester counties, and in Nova Scotia in Guysborough, Halifax, Victoria and Inverness counties. Large quantities are also taken on the Coast of Quebec from the St. Lawrence River to Blanc Sablon in Labrador.

The Squid is universally taken by means of a "jig." This is a cylindrical piece of lead two inches long, having an eye at its upper end, and at its lower a circle of radially arranged, unbaited hooks with the points upwards. These are moved up and down in the midst of the schools of Squid, and when one is hooked (no bait is used) it is quickly drawn up. In using it for bait it is usually cut into three pieces, thus baiting three hooks. When possible it is used fresh, but upon long voyages it has to be salted. It is the best bait for cod known to the fishermen.

In addition to its use as bait it has been employed in Newfoundland as a fertilizer. Ordinarily, it is far too valuable to be used for this purpose, but when great masses of them are thrown upon the beaches, as they sometimes are, it would be well for the farmers in the vicinity to remember that they

have this value. Its use as food is not unknown. Rev. Philip Tocque, in his work on Newfoundland, speaking apparently of this species, says: "The Red Indians of Newfoundland esteemed it a great delicacy, it being eaten raw by them. It is rarely eaten by the inhabitants of Newfoundland, being generally considered unfit for food. It is, however, a well-flavored fish, and is excellent either boiled or fried; it tastes much like the large claws of the lobster."

As is well known, it is from the ink of an allied form that the India ink of commerce is obtained. We cannot find that any experiments have been tried to determine the value of this species for that purpose. Probably it would not pay to capture it especially for this, but if worth while the ink bags of those used in the fisheries could be saved, the fishermen putting all good ones aside as the Squid are cut up for bait.

It is interesting in this connection to note that it was long ago upon our own shores considered good food. Denys in his "Histoire Naturelle" of 1672, speaking of the Squid in Acadia, says: "The Squid [Leucornet] is another fish formed about like the cuttle-fish. It has arms around the head of the length of half a foot or thereabouts, with which it takes fish for food. To capture it a fire is made on the shore at the edge of the water. At night on the flood tide it comes towards the land and, leaving the sea, lands high and dry upon the beach which is often found quite covered with it. It is about a foot in length, quite round, larger in the middle than at the ends; the end of the tail is pointed at which there is a border of two fingers in size all around, like a little round shield. It is good to eat roasted, boiled and fried; it makes the black sauce just as do the Calamaries in France, which are little cuttle fishes. These fishes are found there in the sea as large as hogsheads. These latter never come to land, where only the little ones are seen in the spring and autumn."

In the latter sentence we have apparently a reference to the giant cuttle-fish of Newfoundland, lately described by Prof. Verrill. The entire description shows an accuracy of observation which is quite surprising, considering the time and the little attention then paid to such matters.

WORKS OF REFERENCE.

- The Cephalopods of the North-eastern Coast of America. By A. E. VERRILL. Part II., The Smaller Cephalopods. *Trans. Connecticut Academy of Arts and Sciences*, Vol. V., 1880, pp. 259-446. Also in *Rep. U. S. Fish Commission for 1879* (published 1882), pp. 211-450. Also short paper in *American Naturalist*, Vol. VIII., 1874, pp. 167-174.
- The Squid of the Newfoundland Banks in its relation to the American Grand Bank Cod Fisheries. By H. L. OSBORN. *American Naturalist*, Vol. XV., 1881, pp. 366-372.
- Natural History of Useful Aquatic Animals. Pp. 687, *et seq.*

2. *Loligo Pealei* Lesueur.

Long-finned Squid.

[*Loligo*, the ancient name; *Pealei*, for R. Peale of Philadelphia.]

DISTRIBUTION. (a) *General*;—South Carolina to Massachusetts Bay. Cape Ann, St. Croix River.

(b) *In Acadia*;—St. Croix River.

[In June, 1886, the writer found two specimens of this species in a weir at the Devil's Head in the St. Croix River. The only other evidence of its presence in our waters that we have been able to gather, has been obtained from Mr. Henry Frye, of Frye's Island, Charlotte County, a close and accurate observer of all such matters. He says that we have in our waters two kinds of Squid, the "short-tailed and the long-tailed." The former must be *O. illecebrosa*, and the latter can be only the species we are considering. It had not previously been known to naturalists to occur north of Cape Ann, and its distribution and relative abundance in our waters are entirely unknown.

It is altogether likely that the specimens from the St. Croix River belong to the variety *BOREALIS* of Verrill, which the latter established for his specimens from Cape Ann, and which he calls "nothing more than a local or geographical variety."]

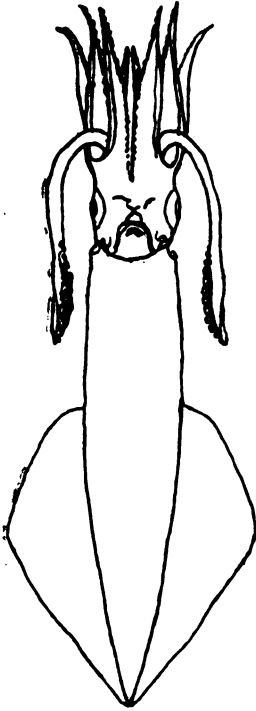


FIG. 2.—*Loligo Pealei*.
Female, one-third of
natural size.

HABITS. In appearance the long-finned Squid differs little from the short-finned, the most marked difference being indicated by their names. In *L. Pealei*, the caudal fin extends over one half the length of the body, clearly distinguishing it from *O. illecebrosa*, in which it is not more than two-fifths of that length. The "pen" in the former is much broader than in the latter. The eggs are laid in gelatinous capsules, attached to some support.

ECONOMICS. It is of precisely the same use to man as the last species, though from its more southern range, it is little used for bait. It is the common Squid south of Cape Cod. It has been tried as food by the New York Ichthyophagous Club, and pronounced "rather tasteless."

WORKS OF REFERENCE.

As for *O. illecebrosa*.

Class GASTEROPODA.

3. *Fusus decemcostatus* Say.

Tritonium decemcostatum Midd.

Neptunea despecta Lin., var. *carinata*.

Neptunea decemcostata Say.

Ten-ribbed Spindle-shell.

[*Fusus*, a spindle; *decemcostatus*, ten-ribbed.]

DISTRIBUTION. (a) *General*.—Low-water mark to forty fathoms. Cape Cod to Sable Island.

(b) *In Acadia*;—(in N. B.) Grand Manan, low-water mark to forty fathoms, *Stimpson*. L'Etang Harbor and Passamaquoddy Bay, *Ganong*. Particularly large, fine and abundant about low-water mark at Hospital Island, Passamaquoddy Bay; (in N. S.) Annapolis Basin, abundant, *Verkrüzen*. Halifax Harbor, *Jones*. LaHave Bank, *Jones* (on authority of *Verrill*.) Sable Island, *Gould* (on authority of *Willis*). Not yet reported from Prince Edward Island or the Gulf of St. Lawrence. Probably rather common in sand and mud on the Bay of Fundy coast, and perhaps less so on the Atlantic shores. May be very rare or quite wanting in the Gulf of St. Lawrence.

HABITS. This is a very striking shell, and one easily distinguished from all others by its ten raised revolving ribs. The ground color is a dull fulvous or yellowish-red, but the ribs are darker. Of these there can always be counted nine, generally ten and rarely more on the lower whorl, of which only two, rarely three, revolve on the upper whorls. The ribs being large and very solid, give the shell a handsome fluted appearance. The lower end tapers to a canal. It is about three inches in length, though frequently somewhat larger. It seems to prefer mud and sand bottoms in rather shallow water on our coasts, rather than rocks in deep water as *Gould* suggests. In L'Etang Harbor it is often dredged with mud, but occurs in greatest perfection and beauty in the clean sand and clear water about low-water mark, at Hospital or Little Hardwood Island in Passamaquoddy Bay. There it lives half-burrowing in the sand, with only its spire projecting at times, and leaving deep furrows behind as it works its way along. Specimens from this locality are very clean and bright and show no trace of the parasitic growths which



FIG. 3.—*Fusus decemcostatus*. Natural size.

seem to be always present on specimens from mud bottoms. We do not know what it feeds upon, but it is probably carnivorous like *Becium undatum*.

ECONOMICS. It is an excellent article of food. Willis tells us that it is "much scarcer and more esteemed as an article of food than *Fusus Islandicus*." We do not find that it is ever eaten by the fishermen or offered for sale in our markets. On the Bay of Fundy coast at least, it is more abundant than *F. Islandicus*, and as it lives near low-water mark, and is not solitary, but gregarious, it may be gathered in larger quantities than the last mentioned species. Nevertheless it is too scarce to be of much commercial value.

4. *Fusus Islandicus* Gould.

Fusus curtus Jeffreys.

Tritonium Islandicum Lovén.

Neptunea curta Verrill.

Sipho Islandicus Chemn.

Spindle-shell.

[*Fusus*, a spindle; *Islandicus*, Icelandic.]

DISTRIBUTION. (a) *General*;—Low-water mark to eighty fathoms. Massachusetts Bay to Labrador, and (if identical with European form) North European Seas to Great Britain.

(b) *In Acadia*;—(in N. B.) Grand Manan, low-water mark to forty fathoms, *Stimpson*. Bay of Fundy, low-water mark to eighty fathoms, *Verrill*. Passamaquoddy Bay, *Ganong*. Gulf of St. Lawrence, over one hundred fathoms, *Verrill*. (in N. S.) Annapolis Basin, abundant, *Verkrüzen*. Halifax Harbor, *Jones*. Pretty common in deep water around the coast, *Willis*. Not yet reported from Prince Edward Island. Probably nowhere very abundant, though to be found on all the Bay of Fundy and Atlantic coast.

HABITS. This is the species described by Dr. Gould, under the above name, but it is now generally considered that it is a distinct species and should be called *F. curtus*. It is so closely allied to the European *F. Islandicus*, however, that it is undoubtedly useful for the same purposes.

The common name of this species is very appropriate, for it tapers to both ends. The shell is very graceful, being symmetrically spired above and prolonged into a slender curved canal below. It is of a dull bluish-white color when deprived of its thin horn-colored epidermis, and is white within. The whorls show a few revolving lines. The animal is white, with small irregular specks of black. It is usually about three inches in length when full-grown.

But little is known of its habits. It probably lives upon animal food. It occupies rocky bottoms, generally in water from thirty to fifty fathoms in depth, though in the Bay of Fundy the strong tides afford it at low-water mark the cold water it needs. It never lives in schools, but singly, on which account it is difficult to obtain it in any quantity, and being comparatively scarce it can never be of much value.



ECONOMICS. It may be used as food. Willis says of it: "Parties who have eaten it inform me that they consider it quite a delicacy." We do not find that it is ever eaten by the fishermen, and it is never for sale in any of our markets. It would doubtless form good bait for cod, pollock, etc. The shells are used as mantel ornaments in fishermen's houses.

FIG. 4.—*Fusus Islandicus*. One-half of natural size.

5. *Buccinum cinereum* Say.

Urosalpinx cinerea St.

Drill, Borer, Snail-bore.

[*Buccinum*, a trumpet; *cinerea*, ashy.]

DISTRIBUTION. (a) *General*.—About low-water mark and in shallow water. Coast of Florida to Massachusetts Bay. Casco Bay, Gulf of St. Lawrence.

(b) *In Acadia*.—Southern part of the Gulf of St. Lawrence, *Verrill*. Prince Edward Island, *Dawson*. Distribution probably coincides with that of the Oyster, though it seems to be nowhere abundant.

HABITS. It is a very rough, dull-colored shell, looking not very unlike *Buccinum undatum*, but is smaller, rougher and generally lighter in color. It is longer in proportion to its breadth, has the revolving

lines more marked and tapers to both ends. The adult is about an inch in length. It has, like other Gasteropod Molluscs, a "tongue" or lingual ribbon, set with sharp siliceous teeth. This ribbon can be moved back and forth so that it acts like a file. It is so arranged that it moves in the arc of a vertical circle, and by its use the animal can bore a clean round hole through an Oyster-shell: then by means of its proboscis it can suck out the juices of its victim. It deposits its eggs in short-stalked capsules on the under surfaces of stones. It lives chiefly upon Oysters, but to some extent upon other Mollusca. It is said not to attack the Mussels.



FIG. 5.—*Buccinum cinereum*.
Natural size.

ECONOMICS. This Mollusc is of importance to man on account of its destructiveness to Oysters. Other Gasteropod Mollusca, such as *Purpura*, *Natica*, *Nassa*, etc., also prey upon Oysters, but their combined ravages are unimportant compared with those of this species. It is very destructive to the beds on the coast of Long Island and New Jersey, and in the Chesapeake. Once having attacked a bed, it is almost impossible to get rid of it. Dredging with fine-meshed dredges and the careful destruction of their eggs wherever found in shallow water, seem to be the methods adopted and recommended for keeping them down. They do not spread rapidly, and its careful removal from seed Oysters in planting new beds would do much to prevent its spread. They seem at times to make sudden and combined attacks on the beds in certain localities. Damage to the extent of tens of thousands of dollars annually is done to the beds in the localities mentioned above.

Such is the case in the United States. But upon our own North Shore we may congratulate ourselves on its comparative scarcity. It seems to do but little damage there. This is doubtless due to the fact that it is a rock-loving species, and the sandy character of the shore is unfavorable to it. In the United States it is chiefly troublesome in rocky situations. We have here another exemplification of the excellence of our North Shore for purposes of Oyster culture, and another protest against our improvidence and lack of wisdom in allowing our splendid opportunities not only to lie unimproved, but to be positively misused.

WORKS OF REFERENCE.

E. Ingersoll. "History and Present Condition of the Fishery Industries," U. S. 10th Census, pp. 232-233; *also*, "Natural History of Useful Aquatic Animals," p. 697.

6. ***Buccinum undatum*** Linnæus.

Whelk, Long Whelk.

[*Buccinum*, a trumpet; *undatum*, waved.]

DISTRIBUTION. (a) *General*.—Above low-water mark to six hundred and fifty fathoms (Verrill); New Jersey to Arctic Ocean and around North Atlantic to Great Britain and France.

(b) *In Acadia*.—(in N. B.) abundant everywhere on Charlotte County Coast; Northumberland Strait, *Whiteaves*. (In N. S.) Annapolis Basin, moderately abundant, *Verkrüzen*; whole coast, *Jones*. Prince Edward Island, *Dawson*. Probably abundant around the entire coast of the three provinces.

HABITS. It has been considered by some writers that our common shore Whelk is not the same species as the *Buccinum undatum* of Europe. But those who have given the question the most recent and most careful study consider them identical; and in any event, it does not matter for our present purpose which is the case. They are so nearly alike in all respects that they are one so far as their uses to man are concerned.

As would be expected from the great variety of conditions as to temperature, depth, freshness of water, etc., under which it is found, this species is quite variable in form, size and color. Yet it presents characteristics which enable it to be always readily distinguished when once a student becomes acquainted with it.

The only littoral shell with which it can be confounded is *Purpura lapillus*. But, unless quite young, it is much larger than the latter, an average size being three inches in length.

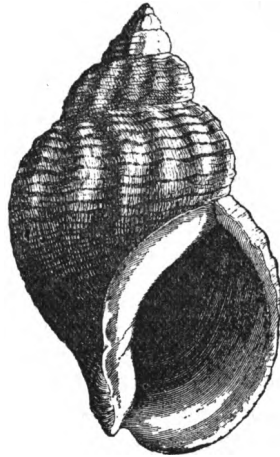


FIG. 6.—*Buccinum undatum*.
Natural size.

The "waves" or rounded longitudinal ridges on the whorls also, twelve or thirteen on each, are but rarely or never seen in *P. lapillus*. Another good distinguishing character, which seems to remain constant for all sizes and ages, consists in the shape of the lowest part of the free edge of the opening, the apex being considered the upper end of the shell. In *P. lapillus* this is more or less angular, and never lower than the lowest point of the columella or central pillar around which the whorls are wound. In *B. undatum*, on the other hand, it is always evenly rounded, and always a little lower than the extremity of the columella. The epidermis is generally yellowish, though variable, and the interior of the shell is frequently of a beautiful golden-yellow. It has been known to grow to a length of more than six inches.

The Whelk is not at all particular as to the kind of shore or bottom it inhabits, or as to its depth. Near low-water mark on our coast, it may be found in mud, sand, gravel, or rocks, feeding chiefly on animal food. At Oak Bay, Charlotte County, they occur in perfection, and their habits may there readily be studied. They are frequently seen at that place feeding upon dead fish, and it is chiefly through their fondness for such food that they are captured in England and Ireland. There round wicker baskets, a foot in diameter, with a hole in the top, baited with cod or other fish, arranged to allow them to get in but not out, are lowered in from five to fifty fathoms of water, and drawn up and emptied at intervals, much as our lobster-traps are. Other methods are, to lower a baited hoop-net, two feet in diameter, or a long line on which small crabs are strung. The Whelks cling to either of these and are readily captured. They must be kept alive for bait. It appears that its love for cod is fully reciprocated, for they are eaten in great numbers by that and other fish, for which it is consequently a very valuable and attractive bait. We do not know that it has been observed perforating other shells as *Natica* and *Purpura* do. It can live in quite brackish water.

Its eggs are laid in lens-shaped capsules, one-fourth of an inch in diameter, each containing many eggs. Great numbers of capsules are deposited together, forming large irregular rounded masses, which are attached to stones or seaweed below low-water mark. The young have the shell well developed before they leave the capsules.

ECONOMICS. This is a Food-mollusc of very great importance in Great Britain. In Vol. VI. of the Fisheries Exhibition Literature we are told, "The edible Whelk is considered a very nutritious and strengthening food, and is always free from poisonous matter. I have heard fishermen say that a dish of Whelks does them as much good as a beefsteak." It may be bought in all the coast towns of Eng-

land and Scotland, and is esteemed as a luxury by the poorer classes of London. To show the importance of this Mollusc in Great Britain, it may be said that a sandy flat in Whitstable Bay was estimated in 1866 to yield £12,000 worth of Whelks annually, a part of the product being sold in London markets for food and the remainder sent to the cod-fishing banks for bait. The Great Grimsby fishery is valued annually at £22,500. For food, they are best in August and September, but are in season all the year round. It is said they should be used the day after being captured, but if boiled they will keep several days. Many vessels are engaged in their capture.

In the United States it does not appear to be eaten, and is used to only a limited extent, if at all, for bait. Dr. Robert Bell tells us, however, that it has been used for bait along the lower St. Lawrence.

In Acadia it does not appear to be known at all as food. Mr. Willis says that though abundant in Nova Scotia, it was rarely used as food.* He tells us further that,—“It is said to be quite as nutritious and delicate, by those who have used it, as the species which is found on the British coast.” It is never exposed for sale in our markets, and is unknown even by name to dealers in St. John. We do not find that it is used by our fishermen to any extent as bait.

In Europe, the fishermen call the eggs “sea-wash balls,” and as they form a lather with salt water, use them, when found, instead of soap for washing their hands. The shells are sometimes used as a decoration for the borders of flower beds and for other similar purposes in places near the sea. It is asserted in the “Natural History of Useful Aquatic Animals,” (p. 699), that this species has been the subject of successful experiments for the obtaining of dyes, though we are not given any particulars.

Is it not a remarkable fact that a fishery of so great value in Europe should be entirely neglected here? There can be no doubt, however, that in the course of time the Whelks will come to be extensively used in Acadia. This will come

*Recipes for cooking *B. undatum* may be found in Tryon's Manual of Conchology, Vol. III., pp. 179, 180.

to pass as the country becomes more populous, and as our poor classes become poorer, as the history of civilization tells us they must. It is chiefly by the poorer classes that the Whelk is used in England. When the fishery does begin to become of importance, regulations for its protection should be enforced from the first. In England, the only restriction that is found to be needed, is as to the taking of the young; those under one and three-fourths inches long must be returned to the water.

7. ***Purpura lapillus* (Lin.) Lamarck.**

Purple-shell, Dog-periwinkle, Dog-whelk.

[*Purpura*, Tyrian-purple shell; *lapillus*, a little stone.]

DISTRIBUTION. (*a*) *General*;—Between tide marks and in very shallow water. Long Island (rare South of Cape Cod) to the Arctic Ocean; around the North Atlantic to Northern Europe and south to the coast of Africa. North-eastern coast of Asia to Japan; Sitka, Alaska, and possibly south to California.

(*b*) *In Acadia*;—(in N. B.) Very abundant on the Bay of Fundy coast from Grand Manan to St. John and probably much further. Not reported from the North Shore, but surely occurs there. (In N. S.) Annapolis Basin, abundant, *Verkrutzen*; all rocky shores, *Jones*; Prince Edward Island, *Dawson*. Probably occurs everywhere on our coasts in rocky places and tolerably clear water.

HABITS. So variable is the shell of this animal, and so few constant characters does it present that it is difficult to describe it. It is, without doubt, the most variable shore shell we have. Sometimes, when living in very sheltered places, it is nearly as thin as this paper; again, when exposed on rocky reefs, it may be of a thickness a dozen times as great. Sometimes it is white, sometimes orange, or gray, or brown, or any neutral shade. While usually of a nearly uniform color, it sometimes shows broad revolving bands, one to three in number, of pure white on a dark ground. Sometimes quite smooth, again it is finely sculptured with longitudinal lines of raised scales, and there is every gradation between these extremes. It varies, too, in form, and in length proportional to the breadth. The only shore form which it resembles

is the young of the Whelk, *Buccinum undatum*. From this it differs in the absence of the longitudinal undulations and in the shape of the lowest part of the free edge of the opening. As stated under the description of *B. undatum*, this in *P. lapillus* is more or less angular and never lower than the lowest point (the apex being considered the upper

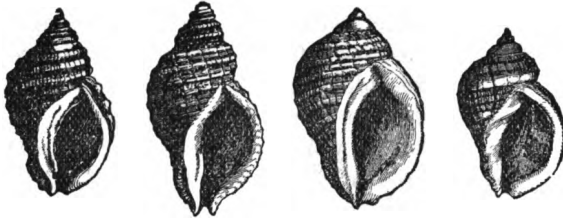


FIG. 7.—*Purpura lapillus*. Natural Size.

end of the shell) of the columella, or central pillar around which the whorls are wound. In *B. undatum* on the other hand, it is always evenly rounded, and always a little lower than the extremity of the columella. Through all its variations, it yet presents a certain individuality of its own not describable in words, which makes it easily recognizable when once the student has become familiar with it.

The Purple-shell lives upon rocky shores between high and low-water marks, particularly near the latter. It rather prefers exposed situations and is often found on ledges exposed to the full force of the ocean swell. It is very voracious and attacks nearly all of the littoral Molluscs, into the shells of which it can easily bore an opening by means of its file-like tongue. One writer tells us that it can bore through the shell of the common Mussel in from three to five minutes, while others, with more show of probability say that it takes two days. Can not some of our teachers or students who live near the shore, throw some light upon such questions at this? Through the hole, not larger than a large pin head, the animal thrusts its proboscis, and sucks out the juices of its prey at its leisure. The Oyster is a favorite food, and great damage is done to Oyster beds by this species. In England it is considered "one of the greatest if not the most destructive of the Oyster's enemies." It has been so bad at times on the English beds that sixpence per hundred has been paid to collectors. It also attacks species of *Littorina*, Limpets, small Naticas and its own kind. It feeds very largely upon the common shore Barnacles, *Balanus balanoides*, thrusting its proboscis between the opercular valves of that species. Its egg-cases, urn or vase shaped, smooth, about one-fourth of an inch long, of a yellow or cream color tinged with pink, are found attached in groups on the under sides of stones, and in crevices of the ledges, at low tide. The young remain in them until their shell is well-formed and they are able to shift for themselves.

ECONOMICS. This is one of a number of Molluscs which furnish rich purple or crimson dyes. Indeed, it was a species of this same genus which afforded a part at least of the famous Tyrian purple dye. Small shells of the genera *Murex* and *Purpura*, containing the animals, together with the color gland alone from larger individuals, were pounded up together in mortars and mixed with five or six times their weight of water. To this was added twenty pounds of soda to each hundred pounds of the mixture and the whole was placed in leaden or tin dishes. It was then exposed to the sun for a few days, until the desired hue was obtained, when the wool was placed in it and left for a few hours. The wool came out dyed unchangeably of the color reserved for the garments of kings and emperors. Indeed, it was far beyond the reach of any but the most wealthy—so very expensive was it. Simmonds tells us in his "Commercial Products of the Sea," that in the reign of Augustus, one pound of wool dyed with Tyrian purple sold for about £36 sterling. This was because of the tediousness of the process, and the small quantity of color obtained from each Mollusc. It is now never used on a commercial scale, partly on account of its expense and partly because cheaper substitutes have been obtained from the cochineal insect and later from the coal-tar or aniline colors.

In the work last mentioned we find the following, referring to the Mollusc under consideration. "If the shell of *Purpura lapillus* is broken, there is seen on the back of the animal, under the skin, a slender, longitudinal, whitish vein, containing a yellowish liquor. When this juice is applied to linen, by means of a small brush, and exposed to the sun, it becomes green, blue and purple, and at last settles into a fine unchangeable crimson. Neither acids nor alkalies affect its color, and it may be conveniently employed in marking linen where an indelible ink is desired." And as Mr. Ingersoll adds, "The housewives of New England, therefore, have growing abundantly on their sea-side rocks little living bottles of indelible ink which cannot be excelled by any manufactured product for either beauty or durability, since neither acid nor alkali will affect its color." In these facts are shown an

interesting though not commercially valuable use for this species. It would be far too expensive a process to attempt to dye with it, but for the purpose suggested (*i. e.*, its use as indelible ink), it may have a limited local value. Jeffreys says the egg-capsules will also give the color, and with less trouble than the parent animals. Dr. Bell states that this species was used somewhat as bait for Cod along the lower St. Lawrence, but we do not know that it has ever been so used in Acadia.

A more important economic interest in this animal for us arises from its relation to Oyster-beds and Oyster-culture. While it gives much trouble and causes much loss to United States oystermen, it seems to be quite rare and harmless on the Oyster-beds of the Gulf of St. Lawrence, doubtless owing to the fact that it lives on rocks, of which there are comparatively few in that region. Indeed Mr. Whiteaves did not find it at all at Shediac. This fact is another to show how favored by nature are Acadian Oyster-waters, and is an additional indication of the possibility of profitable Oyster-culture upon our shores.

8. *Lunatia heros* (Say) Adams.

Natica heros (Say).

Round Whelk.

[*Lunatia*, half-moon shaped; *heros*, a hero.]

DISTRIBUTION. (*a*) *General*;—Low-water mark to forty fathoms. Georgia to southern coast of Labrador.

(*b*) *In Acadia*;—(in N. B.) Abundant everywhere on sand and mud bottoms on the southern coast, from Grand Manan to Quaco. Near Dalhousie, *Bell*. Shediac, *Whiteaves*. (In N. S.) Annapolis Basin and St. Mary's Bay, *Verkrüzen*. All sand beaches, *Jones*. Sable Island, very large, *Willis*. Prince Edward Island, *Dawson*. Probably to be found on sandy and other soft beaches around the entire coast.

HABITS. Though this species possesses little economic value, it is a most conspicuous shore shell. It is as large as *Buccinum undatum*, or

larger, and nearly as abundant. With that species it cannot be confounded, for it has a very low spire, no waves, lines, or sculpturing of any kind except the simple longitudinal lines of growth, and an aper-



FIG. 8.—*Lunatia heros*. Natural Size.

ture simply rounded below with no sign of a notch or canal. It is generally ash colored, and about two and a half inches long and two inches broad. It grows much larger than this, however, in favorable situations, and Willis mentions that he has had specimens from Sable Island measuring four or five inches in length, and broad in proportion.

The Round Whelk is rarely found in rocky situations, preferring sand and mud bottoms. It is not as particular about the purity of the water it inhabits as

is generally supposed, for it is found up the St. Croix River at the Raven's Head and perhaps further. On the flats of Oak Bay, especially on the borders of the deeper parts, it is exceedingly abundant, and there its habits may be easily watched. It not only lives on the surface, but beneath it, the great expanded muscular foot enabling it to burrow readily.

Everywhere on the flats around our coast, there may be found valves of Mussels, Clams and other shells, many of which show a neatly bored round hole, one sixth of an inch in diameter. These are the remains of the victims of *Lunatia*. Grasping the shell with its powerful foot, it rasps a hole through it with its file-like tongue, inserts its proboscis, and sucks out the juices and soft parts. Not only bivalves, but various Gasteropods* are attacked by it, and it is said even its own young. It even attacks successfully the great Beach-clam (*Macra solidissima*). It also feeds upon dead fish. Small specimens are frequently found resembling this species in shape, but showing three revolving chestnut-colored bands. These are now considered a variety of *L. heros*, and are called var. *triseriata*. Its egg-masses appropriately called "Sand-saucers" are quite common on the flats. The eggs are arranged in a "mass of sand glued together into the shape of a broad bowl, open

*The writer saw last summer, at Oak Bay, a large *Buccinum undatum* which had been attacked by a *Lunatia* little larger than itself. Though the boring had not commenced, the former was completely enclosed by the foot of the latter and had its aperture quite covered with a sticky slime. It at first seemed dead, but on being placed in water revived and seemed none the worse for its adventure.

at the bottom, and broken on one side." This bowl is two to four inches in diameter. By holding it up to the light the eggs may be seen.

ECONOMICS. It does not appear that the Round Whelk is used either for food or bait, though it is probably well suited for both purposes. Willis says,—“It is slightly sought after as an article of food, and never offered for sale in any of our markets.” Can any one to whom these pages may come, tell us of any other uses to which the species is applied?

It is not considered in the United States that it does any considerable harm to the Oyster-beds. Mr. Whiteaves found it on the Oyster-beds at Shediac, but we have no information as to whether it does much injury. It is eaten by several fishes.

9. *Littorina litorea* (Lin.) Forbes and Hanley.

Periwinkle, Winkle.

Mic-mac Chigujich-k.* *Acadian French*, Biourneau (?).

[*Littorina*, littus, the sea-shore; *litorea*, living on the shore.]

DISTRIBUTION. (a) *General*;—Between tides. Long Island Sound to Gulf of St. Lawrence.

(b) *In Acadia*;—(in N. B.) Bay of Fundy coast, abundant. Bay Chaleur, *Morse*. Northumberland Strait, *Dawson*. (In N. S.) North Shore, *Dawson*. Halifax, abundant, *Willis*, *Verkrüzen*. All rocky shores, *Jones*. (In P. E. I.) South Shore, *Whiteaves*. Large and abundant on different parts of the coast, *Dawson*. It probably occurs in all rocky situations around the entire coast of the three Provinces.

[This is now almost universally admitted to be an introduced Mollusc. Its home is in Europe and it is exceedingly abundant on the coasts of Great Britain. It was first reported from Halifax in 1857, by Mr. John Willis, but Sir William Dawson states that he collected it in the southern part of the Gulf of St. Lawrence earlier than this, and Prof. E. S. Morse received it from Bathurst in 1855. It was found near St. John by Mr. G. F. Matthew in 1861 or 1862. It was unknown on the

*Applied probably to the native form, *L. palliata*.

coast of New England prior to 1868, but has since spread southward very rapidly, reaching Casco Bay about 1873, Cape Cod in 1875, New Haven, Conn., in 1879. The evidence bearing upon the question of whether or not it is introduced, would be out of place here. It will be found in the work by the author, cited below].

HABITS. It is not difficult to distinguish this shell from our other littoral rock-loving Gasteropods. Our native Periwinkle, *L. palliata* resembles it most closely; but that is much smaller, much thinner and lighter and entirely lacks any of the revolving raised lines so well



FIG. 9. — *Littorina littorea*. Natural Size.

marked in *L. littorea*. This latter character marks it off well from young specimens of *Lunatia heros*. From *L. rudis* it is separated by its greater size and, the greater number and less prominence of its revolving lines and by the shape of its mouth or aperture; in *L. rudis* the latter is nearly round, in *L. littorea* it is pear-shaped. From *Purpura lapillus* and *Buccinum undatum* it is readily distinguished by the absence of a posterior prolongation of the shell into a canal. Large specimens are over an inch in length, but the average size is a little below this.

The Periwinkle lives on the rocks between tides. It is a vegetable eater, and uses its long file-like tongue or lingual ribbon, which its relatives employ to bore through the shells of other Molluscs, for rasping up minute sea weeds from the rocks. It really grazes on these submarine pastures as do cattle on land. This mode of taking its food results in direct value to man, for in England Oyster cultivators distribute them over the beds to keep the Oysters free from seaweed. It has not been observed to attack other Molluscs. From its living on rocks between tides and possessing considerable vitality, it is liable to be taken on ships with ballast, and it was probably in this way that it was introduced into America from Europe.

ECONOMICS. This is one of the best of our Food-molluscs, a fact proven by the quantities sold both in foreign markets and our own. It is not used as yet to any extent in the United States, probably because it is of so recent introduction and because of its scarcity in the vicinity of the markets of New York—the great mollusc-market of the Eastern United States. In England there are no exact statistics to show the extent of its use, but it is estimated that in London alone more than twenty-five hundred tons, worth fifteen thousand

pounds, are consumed annually. The consumption in other places is enormous also, and many hundreds of people are employed in collecting them. The average selling price is one penny a pint. It is eaten in France and probably in other parts of Europe. There, as with us, it is boiled in salt and water, and the animal extracted with a pin. In France, and perhaps elsewhere, pins are placed beside the plates of diners when these animals are served.

In Acadia our people are beginning to appreciate it. We do not know that it is as yet eaten by the fishermen, but in St. John, Mr. J. A. Turner estimates about one hundred and fifty bushels per year are consumed. Of these, a few come from Nova Scotia, but the greater quantity are collected by hand at and near Point Lepreaux. They sell for about two dollars per bushel wholesale in St. John. A few have been exported to Montreal.

It Nova Scotia, in Willis' time, twenty-five to thirty years ago, it was not used for food. At present large quantities are sold in the Halifax markets. They are gathered on the neighboring coasts and sell for five or six cents per quart. At Bedford Basin, Point Pleasant and other places, the residents on the shores gather them for their own use.

In Prince Edward Island, Mr. J. H. Duvar says it is not eaten.

It would doubtless form good bait, but is more valuable for other purposes. Its habit of cleaning sea-weeds from hard surfaces, utilized as mentioned above by oyster-culturists, may become of importance to us if there ever should be on our Gulf of St. Lawrence coast, as nature appears to have intended there should, a system of Oyster-culture.

As the Periwinkle becomes better known, it will be extensively used, and a time will come when the demand will press hard upon the supply. Though it can never approach the Oyster or the Lobster in value, we should none the less take lesson from the fate of their fishery. As Periwinkles are so small, the young are almost valueless and are hence not likely to be taken; but the reproductive season should be carefully determined for our waters, and during that time they should

be left entirely undisturbed. Its abundance upon our coast will ensure a bountiful supply for some time to come.

WORKS OF REFERENCE.

- Is *Littorina litorea* Introduced or Indigenous? By W. F. Ganong. *American Naturalist*, Vol. XX., Nov., 1886, pp. 931-940 and XXI., 287, 288.

Class LAMELLIBRANCHIATA.

10. *Ostrea Virginiana* Lister.

Ostrea Virginica Gmelin.

Ostrea borealis Lamarck.

Ostrea Canadensis Bruguière.

Oyster, American Oyster.

Mic-mac, Numdumoo-k. *Passamaquoddy*, Bah saps-ske see zik. *Acadian French*, Huître.

[*Ostrea*, an Oyster; *Virginiana*, Virginian.]

[It is not yet known whether the Oysters of our coast are to be referred to one or to two species. Most naturalists at the present time believe the former to be the case, and this is the opinion of the writer of this paper. In any event, it does not much matter for our present purpose and we can best consider them as one.]

DISTRIBUTION. (a) *General*.—Shallow water. Gulf of Mexico to Massachusetts Bay. Southern part of the Gulf of St. Lawrence and waters contiguous. Formerly also in Portland Harbor, Casco Bay, etc.

(b) *In Acadia*.—(in N. B.) Bay Chaleur to Baie Verte, in all favorable situations. Between Caraquette Banks, Caraquette, St. Simon's Inlet, Shippegan Harbor and Gully, Tracadie, Tabusintac, Burnt Church, Bay du Vin, and many other places in Miramichi Bay, Kouchibouguac, Richibucto, Buctouche, Cocagne, Shediac, Baie Verte. (In N. S.) River Philip, Pugwash, Wallace, Malagash, Tatamagouche, River

John, Pictou, Tracadie, Mabou, Margarie, Sydney, Albert Bridge, County Harbor,* St. Mary's River*, Liscombe Harbor*, Jeddore Head,* and nearly everywhere in the Bras d'or Lakes. (In P. E. I.) All around the coast in favorable situations.

HABITS. A species, with a range as great as this, and one found under such diverse conditions, must necessarily present great variations. It would be impossible to give of it a description, either scientific or popular, which would apply to all of its individuals. Sometimes round in outline, sometimes nearly as elongated as the Razor-shell, and with every gradation between these extremes, presenting every possible variation as to convexity and corrugation of the valves, it must be considered the most variable bivalve of our coasts. Many of these variations are due to modes of attachment, overcrowding and other conditions to be considered below, but others depend upon conditions not yet understood, particularly those cases in which a certain general form is characteristic of a special locality.

The Oyster† is a bivalve, as everybody knows, with a hinge of simple mechanism at one end, so arranged as to tend to keep the shell constantly a little open. This is its position when lying undisturbed on the bottom, when weakened, or when dead. But the living animal has the power of closing the valves and keeping them closed by means of the single powerful muscle, the position of which is marked by the purple scars, known as the "eye," on the interior of the two valves. The entire interior of each valve has a rather thick, dark-edged, fringed membranous lining called the mantle, which, when fully extended, is a little larger than the valve and extends like a fringe beyond it. It is this mantle which builds the shell. That of one valve is not connected with that of the other except at the hinge and at one other point near the opposite end. Thus the animal is open or exposed nearly all around and not closed in as it would be if the mantle were almost continuous as in the Clam.

Of the two valves, one is usually flat and the other convex. The latter is the under one as the animal lies undisturbed on the bottom, and in its hollow, as in a dish, lie the other organs. The hinge is at the extreme anterior end, differing thus from the Clam in which it lies near the back of the animal. Inside the mantle, and just behind the hinge is the

*Given by Ingersoll in U. S. 10th Census, "Oyster Fishery," on authority of Purdy.

†As would be expected from its great economic importance, the structure and habits of the Oyster have been very thoroughly studied, and its life history is now as well known as that of any Mollusc. Those who are specially interested will find the subject very fully treated in the works quoted at the end of this article, some of which are easily accessible.

minute mouth, guarded by four large membranous flaps, minutely striated on their inner faces. From among them, there run backward, four other larger folds, transversely striated and with crenulate edges, which follow the most curved or ventral side to the posterior margin, and around it to end near the straighter or dorsal side. These are generally known to oystermen as the "beard." They are the gills, and serve both for respiration as they do in fishes, and also to help collect the food and guide it to the mouth. Just in front of the muscle, in a cavity of its own, lies the heart, which, in a freshly-opened, healthy Oyster, can be seen to beat very slowly. It has three chambers, two auricles and a ventricle, and receiving the aerated blood from the mantle and gills, forces it through the various organs of the body, then a part of it through the gills for aeration again, and so on. The nervous system is quite simple, consisting of two ganglia or nerve-knots near the mouth which control the internal organs, and two others near the great muscle which control the latter and the mantle.

In front of the heart lies a large mass which contains the liver (a very dark brown organ), the intestine and the generative organs. At the breeding season the latter will be found very large, and filled with minute eggs or with a milky fluid (the spermatzoa), according as the animal is a female or a male. The sexes are distinct in the American Oyster, though united in the same individual in the European species,* and there are about as many of one sex as of the other. The posterior end of the intestine is on the dorsal side of the great muscle. The water forced along by minute vibrating rods passes into the animal along the ventral margin, bathes the gills and palps and gives up to them its oxygen and food, and passes out by the dorsal margin taking with it the waste matters. The food of the Oyster consists of minute animals and plants, principally that group of the latter known as Diatoms.

It is on account of the abundance of these Diatoms on muddy bottoms in brackish waters that Oysters flourish and fatten better in such situations than in any others. They never burrow but lie upon the surface, and if accidentally covered with mud must perish. They are found also upon rocky and even sand bottoms, but they grow less rapidly and have more enemies in such places. When lying undisturbed, they are firmly attached to some support by the most convex valve; this is nearly always the left. The upper valve usually is a little lifted by the elastic hinge, and allows of the constant circulation of the water through the animal as described above. If left to themselves they grow to a great size. Specimens a foot or more in length, and about four inches in breadth being found sometimes in deep water.

The breeding habits of the American Oyster have been very carefully investigated by Professors W. K. Brooks and John A. Ryder, and their

*Yet it is never self-fertilized, for the eggs and the spermatzoa come to maturity in each individual at different times.

results are to be found in papers quoted below. The latter naturalist finds that about the latitude of Washington, May, June and July, are the spawning months; it is probable that in our waters it comes a little later. The eggs are about one five-hundredth of an inch in diameter, and an Oyster of average size is estimated to lay at least nine millions of them, while a very large specimen will lay several times this number. The eggs are cast directly into the water, and are not retained in the gills for a time as in the European Oyster. They can swim freely about by means of rapidly vibrating little rods or cilia, and within two or three days they develop a mouth and intestine and a symmetrical bivalve shell, and are ready to attach themselves to some clean fixed support. If the latter be wanting they perish. They are now known as the Spat, and they attach themselves usually by the left valve. They grow with the greatest rapidity, and the new growth of the valves proceeds unequally, making them soon quite unsymmetrical. In ten days they are known to attain a diameter of one-fourth of an inch, in twenty, nearly half an inch, and in forty-eight, one inch. Some specimens, not over eighty-two days old, have attained a length of nearly two inches. This rate of growth was under very favorable conditions; probably in our waters it is much slower. It is much more rapid than the growth of the European Oyster, and in nearly all respects, contrary to the general rule, the American seems to excel its European ally. In from two to three years it is ready for the market, but the very large specimens of some localities undoubtedly require from five years upwards. A warm temperature is required for the development of the young, but the adults can endure long-continued cold without injury.

Oysters have many enemies. Excluding for the present the greatest of all, man (his ravages will be considered below), the most destructive are the Starfishes. These animals, in a way only partially understood, can easily destroy Oysters, and the damage done by them is estimated in the United States at \$200,000 yearly—more than the entire annual value of the Canadian Oyster Fishery. At Bridgeport, Conn., for instance, they destroyed over nine hundred acres of Oyster beds in less than three months, and steamers had to be employed to dredge them at great expense. They do great damage in Europe also. Next in importance comes the Drill, *Buccinum cinereum*, a description of which is given in another part of this paper. The Purple Shell, *Purpura lapillus*, the two Conchs, *Sycotypus canaliculatus* and *Fulgur carica* and some other Molluscs, and various parasitic animals do more or less damage. Upon our own North Shore, our Oyster beds are most singularly exempt from most of these foes—a subject to be again referred to a little later in this paper. Mud, sawdust, polluted water of any kind are all very fatal, but are generally due to human rather than natural agencies.

ECONOMICS. Of all invertebrate animals that live in the sea, perhaps of all invertebrate animals whatever, the Oyster is far the best known. It is very widely distributed, occurring in nearly all the seas of the globe, and there are some seventy species recognized. How far back dates its use by man we cannot say, but the shells are found in very ancient kitchen-middens or refuse heaps in America, and still more ancient ones in Europe. This rather throws doubt upon the story sometimes told that their excellence was first made known by an inquisitive walker on the seashore whose finger was pinched by one and carried for relief to his mouth. The historical accuracy of this tale is still further impugned by the fact that the same is told of the origin of several other excellent edibles.

That the Oyster is a nutritious and otherwise good article of food, all physicians, chemists and human experience agree. A discussion of its value compared with other food substances will be found in the introductory part of this paper (p. 9). It must be remembered that those tables express merely the absolute nutritive value of the various substances, and give no indication of the relative digestibility and other differences which give this Mollusc its chief value.

Though persons are occasionally found (of whom the writer is one), who dislike Oysters, we have never heard of any cases of actual poisoning by them. It is sometimes thought that those which have the gills of a green color are injurious, but repeated chemical analysis and careful experiments have shown that they are quite harmless. The green color is due to a pigment absorbed from their food, which, in such cases, consists chiefly of a particular kind of Diatoms. By feeding them other food for a time, their white color returns, and *vice versa*, by feeding white Oysters on these Diatoms they turn green. Indeed the epicures of Europe esteem the green more highly than the white, and in France there are beds in which they are carefully fed to make them green.

The United States is the greatest Oyster-producing country in the world. According to the census of 1880, this fishery is

worth over \$13,000,000 annually,* more than three times the value of the Cod-fishery. By far the greater portion of this is from natural beds, eighty per cent coming from Chesapeake Bay. They are exported to Canada and to Europe. There is but little in the way of Oyster-culture.

In France, elaborate systems of culture prevail, and natural beds are also extensive; the total yield is about 18,000,000 francs per year. The total yield from the beds of Great Britain is estimated at from £1,000,000 to £2,000,000 worth per year. Holland, Germany, Italy and other European countries also have their beds, but their production is of less value. The distribution of the common European Oyster (*Ostrea edulis*), seems to correspond pretty closely with the limits of those shores on which is felt the influence of the Gulf Stream.

On the shores of Acadia, the Oyster has probably existed much longer than man. No doubt the Indians have used it from very ancient times. We are not able to find that lists of the shells of any of the Indian shell heaps † which must exist on our North Shore have ever been published, but they will surely be found to contain many of the shells of this species. ‡ A single specimen was found in a shell-heap ten miles east of Halifax, and they are found in greatest abundance in the shell-heaps of Casco Bay, Maine, though the Oyster is now extinct there.

*It has been estimated much higher than this; by one good authority at more than twice as much.

† Mr. A. Leith Adams, in his "Field and Forest Rambles," p. 35, says that he examined shell-heaps on the islands in the Bay of Fundy and on the St. Croix River, and in them occurred the Quahog and the Oyster. Other observers who have examined these shell-heaps much more carefully than Mr. Adams had done, have seen no trace of either Quahog or Oyster. Mr. Adams' error is very unfortunate; other writers have quoted and been led to wrong conclusions by him.

‡ Denys seems to imply this. He says, referring to the region about St. George's Bay and the Gut of Canso, "there are found an abundance of good and very large Oysters, and of Mussels, still larger; and also an abundance of Shell-fish of all kinds good to eat, which are the most important means of subsistence of the savages during the spring."

The first European to speak of our Oysters appears to have been Champlain,* who, in "Les Voyages du Sieur de Champlain," Paris, 1613, says that in Bras d'or Lakes, Cape Breton, "there are many islands filled with a great deal of game and Shell-fish of several kinds, among others of Oysters which are not of good flavor."

The next writer to refer to them was Nicolas Denys, in his "Description Geographique et Historique . . . de l'Amerique Septentrionale," and his "Historie Naturelle . . . de l'Amerique Septentrionale," 1672. He tells us that good Oysters were found in the region of the Gut of Canso and the south shore of St. George's Bay, at Malagash, (apparently) at Pictou, at Tatamagouche and at Cocagne, and at Grand Pabou. Of Bras d'or Lakes, he says,—“There are found there only some Oysters which are not good when they are newly fished, because they are too fresh, but they have a property, which is, that one is able to keep them nine or ten days without their losing their water, after which they are salt and lose their insipidness, which is caused by the fresh water of the rivers at the mouths of which they are fished.” And of Pictou River, he says,—“At a league and a half within the river, on the left hand, there is a large cove where is found a quantity of excellent Oysters; those in the passage are almost all round, and further within the cove they are of immense size; there are some found as large as a shoe and almost of the same shape, and all are very full and of good taste.” These extracts are interesting, as showing that the distribution and excellence of our Oysters were known over two hundred years ago; the beds have stood a constant strain since then. Denys describes fully also the method of taking them, which will be referred to below. A few references to them occur in books of the last century† and the early part of the present, and since the publication of the first of the Dominion Annual Fishery

*Excepting the doubtful case given on p. 5, footnote.

† A curious error occurs in a little book, entitled, "The Present State of Nova Scotia," published in Edinburg, in 1787. It says on p. 119, that Oysters have been discovered in Chignecto Bay, "and are now become an article of export to several places."

Reports, we have had constant information in the Reports of Mr. Venning, of New Brunswick, and Mr. J. H. Duvar, of Prince Edward Island, as to the condition of the beds. Mr. J. F. Whiteaves, of the Dominion Geological Survey, has given them some attention; his reports are mentioned below. In the Tenth Census of the United States, Section X., Monograph B, Report on the Oyster Industry of the U. S., pp. 3-11, Mr. Ernest Ingersoll has given a concise account of the history and present condition of the beds and a not very encouraging sketch of their probable future. Other than these we have found no writers who have discussed the Canadian Oyster-beds.

If we pass, now, from human to geological history, the first question which meets us is, how the Oysters came first to be in the Gulf, far removed as they are from their congeners to the south of Cape Cod? This problem has already been briefly discussed in the introductory part of this paper (p. 17.) But the causes which brought about the present condition of affairs are still at work, and are producing slow but constant changes in the beds. A depression of the land is certainly going on in this region and must cause changes in tides and currents, and a more active erosion* of the land and disposition of silt. To this, rather than to the action of ice, as some have thought, is probably to be referred the greater part of the destruction of former large Oyster-beds, the sites of which are marked all around Prince Edward Island especially, by immense deposits of dead shells. Oysters, though they flourish on mud bottoms, quickly perish if mud covers them.

There are other purely zoological causes also at work. The depression of the land must allow the cold waters of the deeper part of the Gulf to come nearer and nearer to the shore, making the conditions more and more favorable for the hardy northern animals, and less so for the more sensitive southern forms. The young of the latter must have warm

*Mr. J. H. Duvar, in a letter to the writer, says:—"The Island itself is washing away at an appreciable rate,—the late Mr. Anderson, Government Surveyor, . . . told me that he had observed and estimated the decrease of the land, at one foot per annum on all its tidal margin."

water for their development. A competition must therefore be going on between the two, which can eventually result in but one way—the extinction of the southern forms.

But does this all mean, that our beds are being exterminated by a power quite beyond man's control? If so, what would be the use of Oyster-culture in our waters?

It is true that the ultimate fate of the beds is probably to be total extinction. Only a change in the present geological processes of this region, a cessation or reversal of the present sinking of the land, can save them. But it must be remembered that the whole process is extremely slow; that it takes time measured not by years but by centuries. It is so slow that for all practical purposes it is theoretical rather than real, and need not enter into the calculations of practical men. Probably, aside from man's direct influence, *i. e.*, as far as natural conditions are concerned, there has been but little change in the beds during the last two hundred years, and there will be as little more during the next two hundred. The very conditions which cause the destruction of old beds, are making new localities available. There is no doubt, that before man interfered, and to a certain extent now, new beds form in new places as old ones are smothered out; and no doubt there are, too, many places upon which new ones would grow, if tides, currents or other agency would once place oysters upon them. There is nothing, then, in the geological history of the Oyster in Acadia, to discourage systematic culture or vigorous efforts to protect and increase them.

It need hardly be mentioned here, that the only Oysters in Eastern Canada are in the waters of Acadia. The following table, compiled from the Dominion Fisheries Reports, shows for a period of fifteen years, the value of the Oyster fishery to each of the provinces and to all Canada.* They are officially considered to be worth \$3.00 per barrel, and dividing the value by three will give the number of barrels.

*There are Oyster-beds on our Pacific coast, but owing to inferior quality and lack of care, they are almost valueless.

TABLE, SHOWING VALUE OF THE OYSTER IN THE THREE OYSTER-PRODUCING PROVINCES OF CANADA.

	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
New Brunswick,	\$73,860	\$45,480	\$38,490	\$30,060	\$28,733	\$23,214	\$33,810	\$23,360	\$36,840	\$25,239	\$17,577	\$20,931	\$35,563	\$83,104	\$54,249	\$49,568
Nova Scotia,.....	600	86,384	4,026	4,965	3,120	2,940	2,754	3,201	5,553	6,810	5,225	4,029	4,786	3,980	4,191	5,148
P. E. Island,			256	82	23,715	62,550	53,706	54,436	60,891	62,445	171,126	116,640	84,870	84,612	99,173	109,344
Total for Canada,	\$74,460	\$92,864	\$42,772	\$35,107	\$50,568	\$88,704	\$90,270	\$86,896	\$103,314	\$94,491	\$193,838	\$151,620	\$125,206	\$170,616	\$187,815	\$184,030

Prince Edward Island produces the greatest quantity; New Brunswick comes next, and that of Nova Scotia is relatively insignificant. The centre of the Oyster-trade in the first of these Provinces is Summerside, and the greater part of the supply is drawn from Richmond Bay. King's County has very few or no beds. Formerly those of Malpeque and Bedeque were very productive and highly esteemed. In New Brunswick, the beds of Shediac and Cocagne have been the most famous, and were among the earliest to become exhausted. Thirty or forty years ago, those of Caraquette and Shippegan were the most productive, but to-day those of the latter place yield but few, and Caraquette and Bay du Vin give the largest returns. In Nova Scotia, the greater part are taken in the Bras d'Or Lakes, at Grand Narrows, Washabuck, Whycocomagh, River Dennis, etc., and at Tracadie, Pugwash, Wallace and Antigonish on the main land.

In Prince Edward Island, it is estimated by Mr. J. Sharp, of Summerside, that about one thousand barrels are required yearly for home consumption in the latter place, and the same quantity in Charlottetown. Considerable quantities are also consumed at other places on the Island, but far the greater portion are exported to New Brunswick and Nova Scotia, and the upper Provinces. A few are exported to Newfoundland, and lately a few to Chicago and Milwaukee.

In St. John, Mr. J. A. Turner estimates that no less than ten thousand to twelve thousand barrels of Oysters are consumed annually; of these all but about five per cent are native, the United States Oysters being imported during the close season and in the winter. The former cost about \$2.50 per barrel in St. John, and the latter from two to three times as much.

In Halifax, Mr. Wilson, a large dealer, thinks that from one thousand five hundred to two thousand barrels are used annually, and about twice that quantity in the entire Province. About one-tenth or less of these are United States Oysters; the remainder are the greatly preferred natives. The latter cost about two dollars and fifty cents to importer and three dollars per barrel to the consumer, while the former

cost from five dollars per barrel upwards, and are imported chiefly in the winter.

All agree, that price and other conditions being equal, our native Oyster is preferred to the imported, on account chiefly of its better flavor.

We have not been able to prepare statistics to show the value of the importation of United States Oysters into Canada. But it is enough to say that Canadian beds do not produce nearly enough for Canadian needs, and not too much to say, that Canadian beds are capable of supplying Canadian needs and much more, if properly managed.

The immense fertility of the Oyster can find no more forcible illustration than the above table. That in the face of reckless and unrestrained over-fishing, destruction of the young, pollution of the water by mills, and, in a measure, by mud-digging machines, cutting to pieces of the beds by the latter, disregard of the spawning season and other grievances, the Oyster-yield should be actually increasing is surprising enough. This continuation of the supply, however, has been in great part due to the discovery of new beds as old ones became exhausted, and the utilization of previously known but inferior ones; but we must now be well nigh their end. It is interesting to note, as one must in looking over the Fishery Reports, how the point of greatest productiveness has shifted about during the past fifty years. Our beds have always been considered public property,* to be fished by any-

*Denys' description of the mode of taking the Oyster prior to 1672, is not only interesting in itself, but in many respects would stand as a description of operations to-day.

"I have spoken of Oysters in the first book, but I have not told you that they are a great manna for the winter, when the season does not allow of going a-fishing. They are in the coves or on the coast near the land. To get them, the ice is broken, a large opening is made; then are provided slender poles long enough to touch the bottom. Two of them are bound together about the middle, then they are opened and closed like tongs. They are taken from the water and thrown upon the ice. This fishing is never resorted to unless there are several persons; some fish, another makes the fire, another shells them for frying, others place them on the coals, two or three in a large shell, with their water, with crumbs of bread and a little pepper or nutmeg. They are cooked like this, and it is a good feast, and when they are well filled, each one takes his load, and the dogs draw, each one a bag-full on a little sled, which is made very light for them; harnessed like a horse they go always running over the ice or snow; they are the ones which carry all the equipage of the hunters."

Oysters are still taken in Acadia by tongs or rakes. The dredge is never used.

one and his neighbor, and laws for the rational protection of the fishery have been imperfect or provided no means for their own enforcement.* There is by law a close season, from June 1st to the 15th of September, but is only partially observed. The true condition of affairs has been repeatedly pointed out by the Fishery Inspectors, and remedies suggested by them. Mr. W. H. Venning, Inspector for New Brunswick, has urged year after year the necessity for government interference, and Mr. J. H. Duvar, Inspector for Prince Edward Island, in his very full reports for 1880-87 has repeatedly summarized the whole matter. To the easily accessible reports of these two Inspectors,† and to that of Mr. Whiteaves, all mentioned below, those interested in the subject should turn.

In Prince Edward Island, and to a certain extent in the other Provinces, the value of Oysters as food is rivalled by the value of their shells as a fertilizer. In the estuaries are immense deposits of dead shells, the remains of old beds killed by silt or other causes. These are mingled with fine rich mud and decomposing animal and vegetable matter, forming a muck of the richest character. Before the plough the shells break up and give the land the lime in which Prince Edward Island is very deficient. This mud is known as Mussel-mud, though in most cases it consists almost entirely of Oyster-shells. It is taken by large machines worked on the ice by horses. As to its value, Mr. J. Hunter Duvar, in his report for 1879, says:—"The digging of Mussel-mud for manure—Mussel-mud being the shells of old Oyster-beds—is very harmful to the live beds, but it is scarcely to be doubted that the benefit to the country is of more absolute value than the preservation of the Oyster;" again in 1880, "It is not saying too much to assert that the product of grass and grain has

* Mr. J. H. Duvar writes,—"In the present unsatisfactory and muddled state of the Oyster-law in Prince Edward Island, nobody will risk private Oyster-beds, but I have on file over thirty applications for sites for culture so soon as the Department will decide on places."

†Those of Mr. Duvar, especially, are admirable expositions of the state and needs of the Canadian Oyster-fishery, and have been much consulted in the preparation of this paper. They are written by one personally familiar with the subject.

been increased one-third by the use of this mud during the few years since it began to be generally made use of." It is clear, as there is other testimony also to show, that the protection of the Oyster must be so managed as to allow of the taking of the Mussel-mud by the farmers.

There are two futures open to the Oyster-industry of Acadia: free fishing by the people and a lingering death, or vigorous government interference and a great and lasting prosperity. This is the kernel of the whole matter—government interference. It has worked well in other countries; it would, under the same conditions, work well in this. The duty of the government, if it take charge of it, would be twofold,—to regulate the fishery on the public beds and to give encouragement to culture by corporations or individuals. As to the first, the position and extent of beds must be determined, and each one given a period of rest, being fished not oftener than once in three years; the close season should be vigorously enforced; fishermen must, under heavy penalties, return to the water all Oysters under a certain size; mud-machines must be restricted to certain places in each district, being given ample liberty but not allowed within a certain distance of any living bed; mills must not be allowed to discharge sawdust into the water within a long distance of a living bed; fishing through the ice should be regulated so that refuse cannot be allowed to fall on the beds. As to the encouragement of culture, laws should be enacted which would give to a culturist as good a right to his product, and as full protection from theft, as has a farmer. Areas in good localities should be set aside and leased for long periods, but as a rule the public beds should not be trespassed upon. Some beds should always be reserved for public fishing; freedom to take wild game under common sense conditions, the Dominion should be very slow to take from its citizens. Private individuals should be encouraged to take their seed-oysters from our own beds, as there are none better nor so good for our climate. A measure which might be needful would be the appointment of a commissioner, who should be a man trained in the best methods of culture of Europe and the United

States, who could give his whole time to the work; who could not only scientifically investigate the needs of our own region, but also direct the work of private culturists.

Oyster-culture has been tried in Acadia, but under many discouragements. Hon. Mr. Pope, in Richmond Bay, Prince-Edward Island, and Hon. Mr. Macfarlane, in Wallace Harbor, Nova Scotia, have had moderate success.* It has been tried, too, as Gaspé, at Bic and at Seven Islands, in Quebec, and in Passamaquoddy Bay, but these are outside the range of the Oyster, and where the temperature is too low in summer for the development of the young.

It is to systematic culture that the Oyster-industry must look for its future. France leads the world in Oyster-culture, England and Germany are far behind, and the United States comes last of all. This whole subject is too vast to be more than alluded to in this paper, but references to the more important works will be found below. Oyster-culture is carried to greatest perfection at Arcachon, in France. There are used elaborate means of arresting the Spat or young by providing clean, hard supports to which they may attach themselves. The latter are either tiles, faggots, old shells strung on wire or other similar devices. As soon as the young are from half an inch to an inch in diameter, they are removed and placed in artificial ponds in which their growth is carefully watched until they are marketable, which occurs in from two to three years. They are usually fattened in special ponds. From this high state of culture down to the simple removal of the Oysters from the natural beds to places favorable for fattening or bloating them (as the case may be) for the market, there is every gradation. A thorough knowledge of the subject is a study for a lifetime, a profession in itself.

There is no doubt that the coasts of the Acadian Oyster-region are extremely well adapted for Oyster-culture. Almost

* Mr. J. H. Duvar recently told the writer that,—“Messrs. Pope's Oyster-farm, at Squirrel Creek, Richmond Bay. . . . is still in profitable existence. W. A. Pope died and the property went to his brother, Hon J. C. Pope. . . . Later, the Oyster-lot lay vacant for a long time, until bought last year by Mr. Richards, who works it profitably.”

everywhere around Prince Edward Island and the New Brunswick coast are shallow salt lagoons as well as many places where artificial ponds could be cheaply made. It has been proven by Prof. J. A. Ryder, that they can be raised in shallow ponds from artificially hatched eggs in the United States, and there is no reason to suppose that the same would not be possible with us. Seed-oysters of the best quality are at hand in the old beds. Another circumstance of the highest importance is the scarcity of Oyster enemies on our North Shore. The Starfish, which does annually more damage to the beds of the United States than the entire Canadian fishery is worth, is rare and does little damage on the North Shore. One old oysterman of Shediac told Mr. Ingersoll, of the United States Census Staff, that he had only seen three Starfishes in his life. *The* "Drill" (*Buccinum cinereum*), though present is not common. Mr. Whiteaves did not find it at all in his examination of the Shediac beds. The same may be said of the Purple-shell (*Purpura lapillus*), another enemy; it is present but rare, and was not seen by Mr. Whiteaves. The writer has made a careful examination of a large box of mud from the North Shore beds, which was taken from the barrels containing Oysters. In this, among the two dozen or more species and hundreds of individuals of Molluscs which live with the Oyster on the beds, not a single specimen of either of these species was found. Again, on the coast of the United States, two very destructive animals are the two Conchs or Winkles, Gasteropod Molluscs several inches in length, the *Sycotypus canaliculatus* and *Fulgur carica*. These are entirely wanting in the Gulf of St. Lawrence, and if our beds are planted from our own, as they should be, there is no danger of their introduction. It surely must be an immense advantage to any culturist in our waters, that some Oyster-enemies are comparatively harmless and others entirely wanting. Doubtless, the reason for the scarcity of the above forms is due to the generally sandy character of the region, most of them being rock-loving species. Tiles for Oyster-culture could be made as cheaply in these Provinces as in the United States, and it is possible that some of our slate rocks could be utilized

for this purpose. Many other minor conditions are also favorable, and there is an immense market both in Canada and the United States, for many times the quantity now produced.

The Oyster has but few uses aside from those mentioned. Its shells are used in Oyster-culture, to spread on the beds for the young to attach themselves to, and they are also much used in road-making in parts of the United States, and they have even at times been burned for lime.

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11. ***Pecten tenuicostatus*** Mighels and Adams.

Pecten Magellanicus Lam.

Smooth Scallop, Scallop.

Mic-mac, Sakskataas-uk. *Passamaquoddy*, Sah qui-took yik.

[*Pecten*, a comb; *tenuicostatus*, slender-ribbed.]

DISTRIBUTION. (a) *General*;—Extreme low-water mark to one hundred and nine fathoms. New Jersey (rare south of Cape Cod) to Labrador.

(b) *In Acadia*;—(in N. B.) Grand Manan, ten to twenty fathoms, rather rare, *Gould*. *Passamaquoddy* Bay and Bay

of Fundy, common, one to one hundred and nine fathoms, *Verrill*. St. Croix River, near Dochet Island, not plenty, *Fuller*. L'Etang and Chamcook Harbors, abundant in former, *Ganong*. Mace's Bay, *Perley* and *G. F. Matthew*. Northumberland Strait, *Whiteaves*. Between Tracadie and Shippegan, *Perley*. (In N. S.) Bay of Fundy Coast, large, *Verkrüzen*. Bear Island Bar, Annapolis Basin, extensive beds, *Perley*. Bedford Basin and Halifax Harbor, *H. Piers*. Whole coast, *Jones and Willis*. Prince Edward Island, *Dawson*. Probably not so abundant in Gulf of St. Lawrence as in Bay of Fundy and on the Atlantic coast.

HABITS. This is one of the most attractive Molluscs of our whole coast. Its smooth, nearly circular valves, one flat, the other convex, and its large size (five to six and even eight, in an extreme case, inches in diameter) will readily distinguish it from any other species in our waters. The under or flat valve is very smooth, free from parasitic growths and of a white or cream color. The upper, usually of some reddish color, while free from the pronounced ribs that so many of this genus have, frequently bears many parasitic forms, Barnacles, Bryozoa, etc. Very many have this valve covered with a gelatinous coating which can be easily removed; this is not an epidermis, but colonies of compound Ascidians of the genus *Leptoclinum*. It is really a beautiful shell, the interior being smooth, white and satin-like; the exterior, especially in young shells, presents delicate and attractive colors, some of them showing beautiful pink and white radiations; while its valves can be utilized for many decorative and artistic purposes.

Our Scallop lives upon hard, sand, or mud bottoms, feeding upon microscopical animals and plants. It has the advantage over all others of our shelled Molluscs in the ease and speed with which it can move about. The powerful adductor muscle can bring the valves together with great force and quickness, ejecting the water on the side opposite the hinge, and thus shooting the animal several feet in the opposite direction. The young Scallops can swim in this way better than the adults, their shells being much lighter. The southern *Pecten irradians* often swims in schools, all together in some definite direction, but we do not know that this has been observed in the species we are considering. The young are eaten by cod and probably other fishes.

ECONOMICS. Our Scallop is not the species which is of so much commercial importance in the United States. The latter is a much smaller species, *Pecten irradians*, the shell of which is covered with very large radiating ribs. But those

who have tried them declare that our Scallop is quite as good food as is *Pecten irradians*. In all probability, methods of capturing, preparing for market, utilization of shells, etc., of the latter would apply equally well to our species.

Pecten irradians is taken on the coast of the United States between Cope Cod and New Jersey. It has been found within the limits of Acadia also, at Sable Island. But it is too rare to be of any commercial value with us. The annual value of the fishery to the United States is about \$28,000 to \$29,000, this being the price received by the fishermen for from 70,000 to 75,000 gallons of the edible parts. The fishery gives employment to about 250 men and 470 women and children. Mr. Ingersoll, in the paper referred to below (a full and interesting treatment of the subject) says of the mode of taking them,—“Scallops are caught by hand-dredging from small sail-boats. The dredges are about thirty inches in width, have a scraper-blade upon the bottom, and in favorable weather several may be thrown over from each boat. In shoal water an iron-framed dip-net is sometimes used on calm days. It is pretty hard work, and entails exposure to very severe weather.” The only part ever eaten is the large muscle which closes the valves. These are cut out, cleaned and sent to market where they are sold by the quart. All other soft parts are utilized for fertilizers, while the shells are valued, above all others, by Oyster-culturists for catching the Spat or young Oysters. Their special fitness for this use comes from their fragility and rapidity with which they fall to pieces under the influence of decay and boring parasites. The young Oysters fall apart as the shells break, and overcrowding, dwarfing and distortion is thus prevented. They become full-grown in little over a year; those born in June of one year being full-grown by the following October and at their best in December. The flesh, while very agreeable to some persons in spite of its sweetish taste, is to others not only disagreeable, but actually injurious, producing sickness.

So much for a southern species. How does our native Scallop compare with it in the particulars above mentioned?

In the work by Mr. Ingersoll, quoted below, he says,—

“The great *Pecten tenuicostatus* on the coast of Maine and the Bay of Fundy, was formerly highly valued by the people of that region, but now is too scarce to appear on the tables of even ‘the rich’ except at rare intervals.” . . . “The huge, smooth-shelled *Pecten tenuicostatus* of the north, as big as a fruit-plate, which formally abounded on the coast of Maine, has now become so rare as to be a prize in the cabinet of the conchologist rather than an edible commodity—a result unquestionably due to over-greedy catching.” We believe that while the case here stated may be true for the Maine coast, it is not so for New Brunswick and Nova Scotia. Large numbers of them still live in L’Etang Harbor and other inlets both on the New Brunswick and Nova Scotia shores of the Bay of Fundy. From the former locality large quantities are occasionally brought in schooners to St. John.

Mr. Willis, thirty years ago, said it was common on the whole coast of Nova Scotia, and that it “furnished the residents of Lunenburg, Mahone Bay, Chester, etc., with many a rich treat. In these localities it is said to be very abundant, and more easily obtained than in most other parts of the Province.” Nicolas Denys knew of their abundance there, for in 1672, he says of La Have Harbor,—“In which there are countless numbers of Scallops [Conniffle], which are great stell-fish like those which the Pilgrims bring from St. Michael and St. James. It is excellent eating.” The fishery returns for Nova Scotia give the only official notice of Scallops which are given for any of the Provinces. That of 1886 gives 300 dozen Scallops as taken in Lunenburg County, worth fifty cents per dozen, or \$150; that of 1887 gives for the same county 600 dozen, worth \$300. In New Brunswick, a schooner occasionally brings a quantity to St. John from L’Etang Harbor or Mace’s Bay where they are taken by dredges, and they are sold direct from the vessel. The quantity thus sold is estimated to be about two hundred bushels annually. It is frequently eaten by the fishermen of the Charlotte County coast. In the Halifax market, not many are sold. The usual price is fifty cents per dozen, but not infrequently they bring much more. In Prince Edward Island

it is sometimes eaten, though according to Mr. J. H. Duvar, it is not much esteemed there. It can be taken, he says, in moderate quantity. No Scallops are imported from the United States into Acadia.

As to the value of our species for food, as compared with the southern form, the testimony is all one way. Mr. Willis says that it, and the species next to be described, *Pecten Islandicus*, were considered delicacies in Nova Scotia, and that he had known them, when offered for sale, to sell readily for one shilling sterling each. Mr. Ingersoll, as mentioned above, refers to its excellence, and persons who have tried both have assured the writer that our Scallop is quite as good as the southern form. It has the advantage also of being larger than the latter. The muscle, the only part eaten, must be twice the size.

The shells are made useful for many purposes, and here, again, our species has the advantage. The valves are frequently used as dishes in fishermen's families, and even by professional cooks. Indeed, it is said that, "From its use, by cooks now, this shell [*i. e.*, Scallop shells in general] has given the name to 'Scalloped' oysters." The valves of the young of this, and those of the following species, are made to form part of pin-cushions, needle-books and other like ornaments, while the entire valves are sometimes used as mantel ornaments. The smooth, satin-like interior faces, particularly of the flat valves, take both oil and water colors well, and frequently are used as plaques for painting upon. Their use by Oyster-culturists has been already referred to, and our species ought to be even better adapted for this purpose than *P. irradians*. No doubt there are many other minor uses found for this attractive shell.

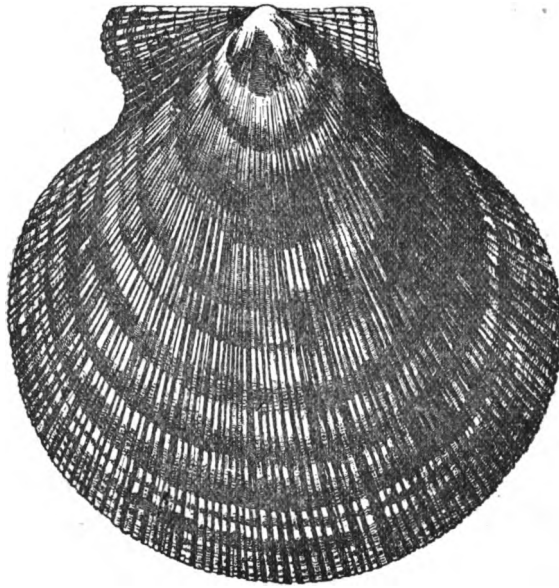
WORKS OF REFERENCE.

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 General Remarks on the Use of the Genus *Pecten* by Man in Modern and Ancient Times. By R. E. C. Stearns. Overland Monthly. Vol. X., April, 1873, pp. 342-344.
 The Scallop Fishery. Fishery Industries of the U. S. Vol. II., Sec. V., pp. 565-581.

12. **Pecten Islandicus** (Müller) Chemnitz.**Scallop, Iceland Scallop.**[*Pecten*, a comb; *Islandicus*, Icelandic.]

DISTRIBUTION. (a) *General*;—Low-water mark to one hundred fathoms. Cape Cod (very rare to the south of it) to the Arctic Ocean and around the North Atlantic to Northern Europe and Great Britain.

(b) *In Acadia*;—(in N. B.) Grand Manan, twenty-five to forty fathoms, shelly bottoms, *Stimpson*. Common in Bay

FIG. 10.—*Pecten Islandicus*, Natural Size.

of Fundy, low-water mark to one hundred fathoms, *Verrill*. L'Etang Harbor, large, though not abundant, *Ganong*. (In N. S.) Annapolis Basin, few small specimens, *Verkrüzen*. Whole coast, *Jones*. Halifax Harbor, *Willis*. Not yet reported from Prince Edward Island. [Rev. George Sutherland, in his *Natural and Civil History of Prince Edward*

Island, 1861, mentions Scallops, "with large ribbed shell, and serrated edge," as occurring on the coast of Prince Edward Island. This description would apply both to this species and the following, but better to the latter than the former.] Probably rather common on Bay of Fundy and Atlantic coasts, and much less so in the Gulf of St. Lawrence.

HABITS. This is a more northern species than the last and less abundant in our waters. It is much smaller than the latter, rarely exceeding four inches in diameter and is readily distinguished from it by its raised radiating ribs, fifty to one hundred in number, which bear closely crowded, transverse, erect scales. The "ears" or triangular projections from the valves which form the hinge, are unequal in size and shape in this species, though equal in *P. tenuicostatus*. In habits it appears to resemble the latter very closely, living in perhaps more rocky situations, but moving, taking its food and so on, in the same way.

ECONOMICS. In its usefulness to man, this species cannot be distinguished from *Pecten tenuicostatus*. It is equally good for food and its shells may be used for the same purposes. Willis tells us that he has known it to be sold with the latter for one shilling sterling, each, in the Halifax market, and that it is quite as delicate food. Its greater scarcity must make it much less valuable. It is probably never taken separately from its larger relative, and is not distinguished from it by the fishermen.

13. *Pecten irradians* Lamarck.

Pecten concentricus Say.

Scallop.

[*Pecten*, a comb; *irradians*, radiating.]

DISTRIBUTION. (a) *General*.—Low-water mark to thirty or forty fathoms. Gulf of Mexico and Florida, north to Massachusetts Bay. Sable Island.

(b) *In Acadia*.—Reported only from Sable Island, by John Willis.

HABITS. This is the Scallop which is of so much importance in the United States markets. As it is so rare in Acadia, indeed hardly coming within the limits of this paper at all, it is not thought best to describe it in detail. When found, it may be distinguished from our two Scallops described above, by the coarse radiating ribs, about twenty in number, and the nearly equal "ears" or lateral projections from the shell, forming the hinge. Its habits resemble those of *P. tenuicostatus*, described above. It is possible that it may be found in the Gulf of St. Lawrence along with the southern shells there, and if not, it is extremely probable that it would flourish there if introduced. Indeed, as mentioned under the last species, a Scallop having a "large ribbed shell and serrated edge," has been described as living on the shores of Prince Edward Island. It may be not improbably this species.

ECONOMICS. Its use to man may be best described in connection with our native Scallop, as both are available for the same purposes.

14. *Mytilus edulis* Linnæus.

Edible Mussel, Black Mussel, Sea Mussel.

Mic-mac, Angadaalow, *pl.* Angadaalak. *Passama-quoddy*, Sah tah sis ik.

[*Mytilus*, the ancient Greek name; *edulis*, edible.]

DISTRIBUTION. (a) *General*;—Littoral zone to more than one hundred fathoms. North Carolina to Arctic Ocean and circumpolar. On European coast, southward to Mediterranean and Black Sea; on Asiatic coast to China and Japan; on Western American coast to California.

(b) *In Acadia*;—(in N. B.) Exceedingly abundant everywhere on the southern coast from Grand Manan to St. John, and probably much further. Bay Chaleur, *Bell*. Shediac, *Whiteaves*. (In N. S.) Annapolis Basin and Digby Gut, common, *Verkrüzen*. Whole coast, *Jones*. Prince Edward Island, *Dawson*. Very abundant everywhere on the coast of Acadia.

HABITS. Without doubt, this is the most common and abundant Mollusc on the coast of Acadia. There is probably not a mile of shore on our whole coast line which is without it, and everybody who visits

the sea-shore must know it well. There is only one common Mollusc at all likely to be mistaken for it—and that is the Horse-mussel, *Modiola modiolus*. But the former is blue-black generally, and the latter is chestnut, or rather its epidermis is, and their situations or habitats are different, as will be seen by reading the descriptions of both. A good mark to separate them is found in the position of the umbo, or raised knob around which the concentric lines of growth of the shell are arranged; this is at the extreme end in *M. edulis*, but set a little back near one margin in *Modiola modiolus*. Its lack of raised ribs distinguishes it from *M. plicatula*.

This species varies somewhat in color, the variant individuals being of a darker or lighter horn-color, and generally showing radiating, longitudinal, dark lines. These forms are by some considered to form a distinct variety—to which the name *pellucidus* is given. Within, the

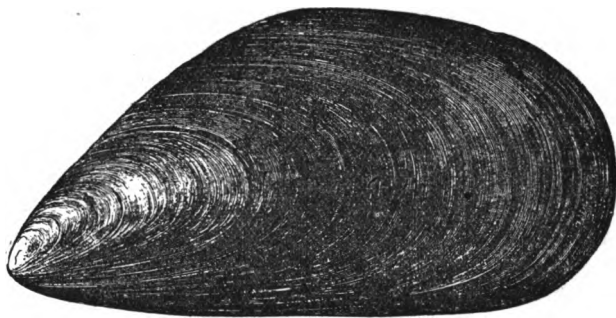


FIG. 11.—*Mytilus edulis*. Natural Size.

shell is dark-violet, silver and white, and often very beautiful. The average length of adults is about three inches, though they grow as great as five, and even over eight inches in rare cases in Europe. They vary greatly in outline, the nature of the variation of an individual depending chiefly upon the conditions under which it has grown.

It is a fact of no little importance to man, as will be presently seen, that the edible Mussels are gregarious. All visitors to the shore remember well the great beds, often acres in extent, which are found on the flats, especially of estuaries. They never burrow, but instead, fix themselves by means of a mass of silky threads which are secreted by the foot and pass out between the valves. With these they can attach themselves to any surface, sand, mud and gravel, rocks, piles of wharves, buoys, bottoms of boats, and, in fact, almost anywhere. They prefer, however, mixed gravel and mud flats where the water is not quite pure, but has some admixture of river water. The mud flats they add to, both by

collecting sediment among themselves, packed closely together as they are, and by their own decay and decomposition. The beds are found both between tide-marks and in shallow water, and the latter produce the larger specimens. Indeed, the largest are found isolated, for the crowded, tangled mass in the beds does not allow of large growth.

Though ordinarily fixed by the byssus, they can travel a little when needful. The foot is thrust far out in advance to attach new threads by which it draws itself along, breaking off the old ones behind. It lives upon microscopical animals and plants, chiefly upon the latter. It has some enemies, chief among them, the food fishes, all of which are exceedingly fond of it. Crows, the Purple-shell (*P. lapillus*), the Starfish, and (in England) the Sea-urchin, all are destructive to it.

The height of the reproductive season appears to be April and May. The young, after leaving the body of the parent, swim about for a few days and then settle upon some firm surface. They grow very rapidly; there are cases known in which they have grown to full size (three to four inches long), in one year. In most cases, however, they require two or three years.

ECONOMICS. Our edible Mussel is, without any question, identical in all respects with that of Europe. And without any question, also, it is adapted for the same uses. In Europe, the uses to man of this species may be roughly classed under four heads, the following being their order of importance.

- a. As bait in the fisheries.
- b. As human food.
- c. As a fertilizer.
- d. Minor uses for ornaments, etc.

In America the order is quite different. The third in the list certainly stands first, but it is difficult to state the order of the other three, which apparently stand about on an equality. In Europe, it is a Mollusc of great importance, being second only to the Oyster; we almost ignore it. There, it entirely replaces our common Clam, which, though abundant, is rarely used either for food or for bait. Is it not a curious fact that each country should prize the one the other neglects? Why do they not each value both? It would be interesting to learn how this condition of affairs came about in this country; in other words, how the early settlers, always conservative of old customs, and used to European ways, abandoned them and took to new? Did they imitate the

Indians, who, we know, used the Clam to the almost total neglect of the Mussel? And are not the Europeans of to-day wiser than we in this respect, that they use a form, which, equally good with the other, lives on the surface and can be easily gathered, and besides is susceptible of easy artificial cultivation anywhere, while we take that for which we must laboriously dig, which requires more special conditions of soil, and which, only with difficulty, can be artificially propagated? A consideration, therefore, necessarily brief, of the economics of this species in Europe, may suggest some useful lessons to us.

(a) ITS USE AS BAIT IN THE FISHERIES.

We are told of its use in England (Fisheries Literature) that,—“The Mussel is admitted on all hands to be the most deadly bait for salt-water fish;” and again,—“The Mussel is perhaps the best kind of hook bait known.” What have our fishermen, who use the Clam and the Squid, to say to this?

In England and Scotland it is especially valued, and it is estimated that no less than the enormous quantity of one hundred thousand tons annually are required for this purpose in Great Britain alone. The single port of Eyemouth required for its fishing vessels during the season of 1881–82, eight hundred and ninety tons of Mussels. Three Scottish villages have been known to use, in one week, sixty-one tons.

These figures will show what an enormous drain upon the Mussel beds of Britain there must be for this purpose alone, not taking into consideration those used for food. It has been too great for the natural product, and the fishermen have been forced to importation and to artificial cultivation. In 1881, twelve thousand tons, mostly for bait, were imported from Holland into England.

They are gathered by those who make a business of it, by hand, when above low-water mark, and by a sort of grapnel-dredge when below it. They are taken to the fishing grounds

* As shown by the Indian shell-heaps. Lescarbot (1609) corroborates this in the following.—“But yet they [*i. e.*, the Mic-macs] have a superstition, not to wish to eat Mussels. Yet they cannot give a reason for it. . . . Nevertheless in our company, seeing us eat them, they did likewise.”

alive (our fishermen take their Clams and Squid salted), and they will remain so for some hours (one writer says for two days), when placed on the hook and suspended in the water. It is thought that this fact is the chief element in its success as a bait. It is used for all kinds of fish which bite at a hook, cod, haddock, etc., and although in deep water and far from land, Whelks (*Buccinum undatum*) are sometimes preferred, the Mussel is much the best all-around bait. The Swedish fishermen use it in preference to all others, as probably do other European fisher-peoples.

In the United States we cannot find that it is ever used for bait, nor in any part of Canada, except very rarely and locally. In Acadia, we do not know that it is ever used for this purpose;* can any one tell us the reason? It is more abundant and more easily obtained than the Clam, has a lighter shell, is easier to open, is probably more tenacious of life, and has other apparent advantages.

(b) ITS USE AS HUMAN FOOD.

Of all European countries, France probably uses the most Mussels for food. In 1873, the fishery was estimated to be worth \$160,000, in part from natural and partly from cultivated beds. Belgium also produces many, and it was estimated in 1873 that there was exported from Antwerp to Paris alone £280,000 worth, all taken from natural beds. From many parts of the English coast they are sent inland, where they are eaten in all towns, but the greater supply for the London market is imported from Holland. In London, £4,000 worth are sold annually for food, at a price of about one penny per quart, ranking in value as the third shell-fish, the Oyster being first, and the Periwinkle second. Statistics for the whole of England are wanting, but the quantity must be enormous. It is used largely as a substitute for Oysters—in making fish-sauces, and is also cooked in other ways. In

* As this paper is in press, Mr. H. Piers writes the author that on the Atlantic coast of Nova Scotia, "they are not sold for bait, but are occasionally used by the fishermen when nothing better can be had."

France, they are considered good throughout the year, but at their best in August and September.

In the United States, New York is the centre of its use as food. Considerable quantities are there pickled and sent inland. The total annual value of the Mussel fishery in the United States is estimated at about \$37,500, but of this a small part only is for its use as food; its chief value is as a fertilizer.

In Acadia, it is but little used for food. It is very rarely used by the fishermen, and is quite unknown in the markets of St. John. In Halifax, Willis said of it thirty years ago, that it could be purchased in the markets when in season, of large size and fine flavor, for about two shillings sterling per bushel. It is still sold in the Halifax markets, though in small quantities. The usual price is ten cents for a half-peck, or about fifty or sixty cents a bushel.

In Prince Edward Island it does not appear to be used at all for food.

As to its general excellence as an article of food there can be no question. Some tables, to show its value compared with other shell-fish, will be found in the introduction (p.9). In Europe, it is eaten by all classes, but is especially a luxury of the poor. Gould says that he has been "assured by a friend of acknowledged good taste, that when cooked it is more palatable than the common Clam;" and in this opinion many others will concur. But at the same time, it is undoubtedly true that there are persons who not only dislike them, but to whom they are very injurious. Each person must determine this for himself, using them at first with caution.*

It is true, also, that in addition to this occasional constitutional danger, Mussels are sometimes, though very rarely, really in themselves poisonous, and injure everybody who may eat of them. Such cases, however, are no more frequent than poisoning by eating partridges in the spring is with us, and not nearly so frequent as is poisoning from eating canned fruits and meats. This, therefore, should be no hindrance to their use, proper precautions being observed.

* The symptoms, which must serve as danger-signals, are great swelling in the head and the abdomen and the appearance of red spots on both.

As to the cause of the poisoning, we have not perfectly satisfactory knowledge. In general, it appears to be due to the exposure of the Mussels to impure waters. Some years ago a case of violent poisoning in Wilhelmshaven, in North Germany, which resulted in the death of several persons, led to a careful investigation. It was shown that the fatal Mussels had been taken from the harbor of the town, in which the water, though salt, is quite stagnant, clear water entering in small quantities at high tide only. Fish could not live in it, and even the all-enduring eel became weak and helpless. Experiments proved that all the Mussels of the still water were poisonous, but that upon being removed to clear water they quickly became harmless; on the other hand, perfectly good Mussels, placed in the harbor, were soon very poisonous. Prof. Virchow found that only the liver contains the poison, and that it can be rendered harmless by cooking the animal in a solution of soda. The best antidote is said to be a quantity of milk. The safest way, according to this investigator, is to remove the liver from every specimen to be eaten. It is a large yellowish-brown soft body enclosing the stomach on the upper side, and involved in numerous loops of the intestine. The conclusion to be drawn from these facts is, that Mussels from stagnant or impure waters should always be avoided, and everybody ought, before eating them, to know whence they came. It is thought, too, that they may be injurious when taken from docks in which copper-bottomed ships are moored, or from harbors in which there are mineral lodes exposed to the action of the water. Several writers have thought that the striped variety (*var. pellucidus*) is poisonous. As mentioned above, however, these cases of poisoning are very rare, and should prove no impediment to their free use, proper precautions being taken to bring the supply from pure waters.

(c) ITS USE AS A FERTILIZER.

When a great bed of Mussels is exposed on a flat in an estuary, it is constantly catching the fine silt which the fresh water deposits when it meets the salt. The animals live their short lives, die, and are buried beneath their progeny. The

lime of the shells, their animal matter, and the rich silt, go on accumulating, and soon form a mass of the richest fertilizer.

In Europe this fact has been fully recognized, but there the living Mussels are far too valuable to be used to any extent for this purpose; so valuable, that it has been proposed in England to make it a penal offence to take them for manure. The latter step is necessary because of the near-sightedness of the farmers, who would totally exterminate them if allowed.

In the United States, it is taken along the coasts of Long Island and New Jersey in enormous quantities for this purpose, though it does not seem to be much used farther north. Its value to the United States is estimated at \$37,500 yearly, nearly all of which is for its use as a fertilizer.

In Acadia, all have heard of the "Mussel-mud" of Prince Edward Island and the North Shore of the two other Provinces. A large part of the Mussel-mud, however, probably very much the largest part, consists of the remains of the Oyster. The subject has been considered at some length under that species. We have found no evidence to show that the Mussels are taken separately for this purpose.

Upon the Bay of Fundy coast, the farmers make but little use of what would appear to be a mine of agricultural wealth at their very doors. Everywhere about Passamaquoddy Bay there are great beds, the use of which ought greatly to benefit the land.

(d) OTHER MINOR USES.

In England, it has been proposed, and it would be equally applicable in this country, to plant Mussels on breakwaters of gravel and other shifting substances, and upon beaches exposed to the wearing action of the waves, in order to bind them together, just as beach-grass is used on the sand-dunes of Cape Cod. They would quickly fix themselves, and by their tough, interlacing, tangled byssi or beards would soon form a tough but elastic coating.

It is thought also that they can be used to prevent the ravages of *Teredines* or Ship Worms on timber of wharves and the like, by coating the latter completely.

Pearls of some beauty are not infrequent in these Mussels, but they are rarely large or perfect enough to be of value. Forbes and Hanley say,—“They are commonly small, ill-colored, and of little value, yet have been at various times much sought for.” They have brought from one shilling and sixpence to four shillings per ounce. In the “First Report on the Fauna of Liverpool Bay,” p. 241, we are told,—“Some years ago, large quantities of Mussels were raked up in Conway Bay, and boiled in huts on the east shore to get seed pearls. These were bought by a traveller at four shillings per ounce. A woman could earn twelve shillings per week at this harvest. The trade has ceased.” Sometimes the whole interior of the shell is covered with little pearl-like excrescences, the result of the efforts of the animal to protect itself from a boring sponge.

Simmonds, in “Commercial Products of the Sea,” tells us of the shells,—“When polished, they are made into pretty needle-books and scent-bottle holders, earrings, crosses, pins and pin-cushions. They are mounted on marble as paper weights, and are used as a receptacle for gold and silver paint for artists. The Maories of New Zealand employ Mussel shells as tweezers to eradicate the hair from their faces.” Mr. Ingersoll says the American Indians also used them for the latter purpose.

The shells are also spread on Oyster-beds by cultivators, as a support to which the young Oysters may attach themselves.

ON MUSSEL CULTURE.

As in the case of the Oyster, the demand for Mussels in Europe is far too great to be supplied from natural beds. Extensive cultivation is the only remedy, and in this France leads all other countries. A full treatment of the subject, for which we have not space here, will be found by those interested, in the volumes of the Fisheries Exhibition Literature and other works quoted below. A very brief outline must suffice here. There are two modes of culture practised in Europe; one known as the British method, in which young Mussels are taken from salt or nearly salt water and trans-

ported to the banks of estuaries where they are exposed for a time at low tides, and where the water is brackish. Both these conditions seem to be necessary to secure their rapid growth and fattening. The presence of some fresh water is a necessary condition to success in Mussel culture. The French method proceeds upon a different principle; it consists in placing convenient supports for the Mussel "Spat," or free-swimming young, to attach themselves to. For this purpose palisades of coarse wicker-work are placed in the path of currents which would otherwise sweep the young away. As soon as they have attained a length of an inch (which is in a little over a year, on an average) they are removed with hooks and placed on the bottom. Later, they are removed to above low-tide mark; again, higher up the beach, and again, still higher, there being four removals in all. In a year after the first removal they are ready for market. There are many of these Mussel-farms in France, the principal ones being at the Bays of Aiguillon and Chatellaillon, at Esuades, Charvon, Marsilly, at St. Valeny-sur-Somme, at Arcachon and other places. The most perfect system is attained at the latter place.

They are also cultivated in the Bay of Kiel, in North Germany, where small trees, fixed upright below low-water mark, have been recommended for catching the Spat.

In England, there is comparatively little done in Mussel-culture as yet. Attempts so far have had to struggle with the drawbacks of imperfect legislation. It is agreed that the culturist should have the same exclusive right to work his area and dispose of his product as has the farmer, and there should be as stringent laws to protect the one from trespass and theft as they are for the other. Such laws, however, until very lately at least, were wanting. It is estimated that an acre of Mussel-beds, properly cultivated, will yield one hundred and eight tons, worth at least fifty-four pounds per year.

The time will certainly come for Acadia when the Mussel-fishery will be a large industry. It is to be hoped that it will be wisely regulated during its life, and not left to be doctored when near its end.

The only way in which the Mussel seems to be of injury to man, excepting the cases spoken of above, is when it grows on Oyster-beds. It grows faster, lives on coarser food, and is altogether better fitted for the struggle for existence than the Oyster. It also collects mud, and by all of these causes tend to crowd out the more valuable Mollusc. We have not heard that it is known to do any injury to our Oyster-beds in this way.

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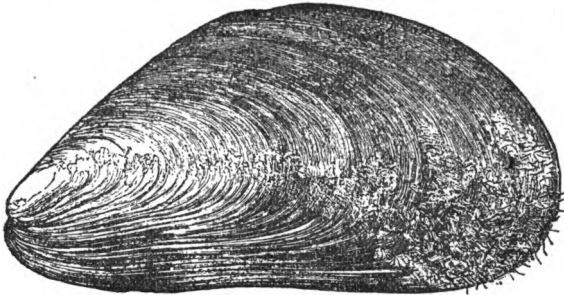
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15. **Modiola modiolus** (Lin.) Turton.*Mytilus modiolus*, Lin.**Horse-Mussel.***Modiola*, a little measure(?); *modiolus*, a little measure(?).

DISTRIBUTION. (a) *General*;—Low-water mark to one hundred fathoms. New Jersey to Arctic Ocean, and circum-polar. On European coast, southward to France; on Asiatic, to northern Japan; on western American, to California.

(b) *In Acadia*;—(in N. B.) Abundant on the southern coast everywhere from Grand Manan at least to St. John. Shediac, *Whiteaves*. (In N. S.) Annapolis Basin, somewhat abundant, *Verkrüzen*. All rocky shores, *Jones*. (In P.E.I.) Not reported but doubtless occurs. Probably to be found in rocky situations around the entire coast.

HABITS. This species more closely resembles *Mytilus edulis* than any other Mollusc. It is generally larger than the latter, growing to a length of six, and in extreme cases, mentioned by Willis, eight inches.

FIG. 12.—*Modiola modiolus*. Natural size.

It never has the blue black color of *M. edulis*, but instead has an epidermis of a dark chestnut or brown color. The umbo (or centre around which the lines of growth of the shell are arranged) is at the anterior or small extremity in *M. edulis*, but set a little back on the hinge margin in this species.

It does not, however, live in great beds above low-water mark as does *M. edulis*. It prefers gravelly and stony bottoms to which, half buried in the former, and half hidden in crevices in the latter, it

attaches itself by its strong byssus, or "beard" of threads. Those torn from their hold in the tide-pools, bring away a large mass of gravel with them. Their mode of life may be well studied in the tide-pools about Passamaquoddy Bay, where they may be seen under the clear water with their posterior ends just above the bottom, gaping widely open. The shells bear many growths, both animal and vegetable, the most important of which are the great *Laminaria*, or "Devil's Aprons," our largest sea-weeds. In storms these often drag their anchors, and the Mussels are thrown up with them on the beaches.

ECONOMICS. The Horse-Mussel is used for food in England, though to no great extent and only locally. Mr. Willis says in his time it was never exposed for sale in the markets of Halifax, and this seems to be true at present. The fishermen eat it very rarely, if at all, unless pressed by necessity. Some of them believe that the byssus or "beard," and probably the foot from which it springs, are poisonous. The writer has been told of two fishermen, who, storm-stayed at the Wolves, ran short of provisions. They ate Horse-Mussels and one of them died a few hours later. If his death really was caused by the Mussels, it is altogether probable that the byssus and foot really are the poisonous parts, and until we have further information on the subject, they had better be removed before the animal is eaten.

This species is also very good bait, and is said to be extensively used for that purpose in Newfoundland. But it is so much harder to obtain than *Mytilus edulis* (every specimen must be torn up by main force, unless carried up by *Laminaria*) and so much less common and less accessible, that it is never likely to be of very much value.

The shells are usually very beautiful within, having often a delicate pearly lustre. They ought to be available for many ornamental objects, such as trays for trinkets, and the like. Occasionally pearls of poor lustre are found in them, but we have not heard of any of value.

In Europe it has been used to some extent to bind together the shifting materials of breakwaters on sea coasts. The tough threads of the byssus bind together everything within reach and a coating of these animals forms a strong and elastic buffer against the force of the waves.

16. ***Modiola plicatula*** Lamarck.**Ribbed Mussel.**

[*Modiola*, a little measure (?); *plicatula*, somewhat folded].

DISTRIBUTION. (a) *General*;—Between tides and in very shallow water. Georgia to Casco Bay, Maine. Gulf of St. Lawrence.

(b) *In Acadia*;—Not formally reported from the New Brunswick coast, but doubtless occurs upon the North Shore. North Shore of Nova Scotia, *Jones* (on authority of (*Willis*). Prince Edward Island, *Dawson*. Probably occurs all around the southern part of the Gulf of St. Lawrence and in Bras d'Or Lakes, and possibly in some part of Chedabucto Bay.

HABITS. This species may easily be distinguished from the common or Horse-Mussel by the longitudinal foldings or ridges of its shell. These begin near the hinge and radiate to all the posterior part.

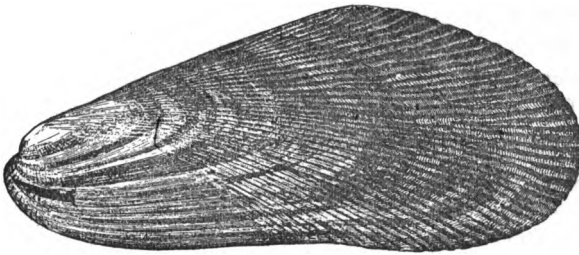


FIG. 13. *Modiola plicatula*. Natural Size.

It lives in brackish water, preferring ditches and sluggish marsh streams. It partly burrows into the mud, well up towards high-water mark, and attaches itself by a strong byssus, or mass of threads.

ECONOMICS. It is sometimes eaten, but is not considered as good as *Mytilus edulis*. It is a useful bait, but comparatively little used, chiefly, no doubt, on account of its scarcity. It does not appear to be used for either of these purposes in Acadia. In New Jersey and about Long Island it is employed as a fertilizer, and in all Probability it occasionally forms a small part of the "Mussel-mud" of our North Shore.

17. ***Margaritana arcuata*** (Barnes) Stimpson.

[The fresh-water Mussels of Acadia have not been well studied. Willis and Jones mention several species as occurring in Nova Scotia; Mr. G. F. Matthew knows of several in New Brunswick; and Dr. Dawson has reported two species from Prince Edward Island. It is uncertain how many of these may produce pearls, perhaps all of them under the requisite conditions. Mr. Matthew tells the writer that Mr. S. E. Gerow has identified *Margaritana arcuata* in the Society's collection, as the pearl-bearing species of our waters.]

Fresh-water Mussel, Fresh-water Clam, Pearl-Mussel.

Mic-mac, Sebooaas-uk.

[*Margaritana*, a pearl; *arcuata*, arched].

DISTRIBUTION. (a) *General*;—Fresh-water streams of North-eastern America.

(b) *In Acadia*;—(in N. B.) Streams of southern counties, *S. E. Gerow*. (In N. S.) Rivers in Annapolis, Sackville River, *Willis*. All fresh-water streams, *Jones*. Not reported from Prince Edward Island.

HABITS. Our fresh-water Mussels are in general not unlike their salt-water namesakes in appearance and habits. The epidermis or outer skin varies from straw-color to olive-green, and is not attractive, but within the shells nearly always show the beautiful changing colors of mother-of-pearl.

They generally lie partly buried at the bottom of the pond or stream in which they live, with the posterior end protruding and gaping open. But by means of their powerful "foot," they can travel with some facility, and one often sees on sandy bottoms the long furrows left by them in their progress. The young are kept for a time in the gills of the parent. Our eastern species present little variety as to shape, size and color, but those of the west show the most remarkable diversity in these respects.

Pearls are, for the most part, found only in old or deformed shells. Mr. Gerow says that young or even middle-aged specimens very rarely or never contain them. They are believed to be formed only as the result of some disease, injury or irritation to the animal. Some naturalists have thought that the free perfect pearls are formed by the

deposition of the pearly material around grains of sand or other accidental intrusions, for the sake of rendering the latter less irritating to the animal, and this is the generally received opinion. The proportion of individuals containing them is, however, very small; not one in a thousand contains a pearl of real value. The Mussels found in clear, running, gravelly streams are most likely to contain them.

ECONOMICS. Pearls are obtained from fresh-water Mussels in several parts of the world, notably China, Japan, Germany, and formerly, Scotland. They are also found in the United States, and some rivers have been systematically worked for them. Those of Scotland were formerly held in high esteem and have brought very high prices. A complete discussion of the subject may be found in the papers mentioned below.

In our own waters some very valuable pearls have been found in the fresh-water Mussel. Mr. S. E. Gerow, of the Customs, St. John, is the most expert and successful pearl-fisher of these provinces. The following facts have been given by him to Mr. S. W. Kain, and the latter has kindly allowed the writer to quote them.

"The largest pearl Mr. Gerow knows of that has yet been found in New Brunswick, weighed fifty-six grains, and was sold to parties in Philadelphia for four hundred and fifty dollars. . . . This was found in a brook near Sussex, Kings County. Mr. Gerow found one himself at Coldbrook, which weighed twenty-five grains, and he sold it for one hundred and fifty dollars. It was a very beautiful pearl of splendid lustre and perfect shape. He found another at the same place worth one hundred and fifty dollars, and weighing nineteen grains. Little New River, he says, is a good place for them. He found one there that weighed eighteen grains, and sold for one hundred and ten dollars. A man who was with him found one that he sold for thirty dollars. Mr. Gerow stated that he had seen a pearl from Nova Scotia that sold for seventy-five dollars. St. John, Kings and Charlotte are the only counties where he knows of much search having been made. Mr. Gerow found another weighing fifty grains, but it was not symmetrical. It was flat on one side, but of a very good purplish lustre. He sold it in New York for one

hundred dollars, and another of similar shape in St. John for the same price." These, of course, are very exceptional instances, the great majority of those found being small, of poor shape and of bad color. It must be borne in mind, in considering these facts, that a great amount of persevering labor and considerable skill is required to obtain such results. Its returns are too uncertain to allow the fishery ever to be of much economic value.

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18. *Cardium Islandicum* Linnæus.

Cardium ciliatum Fabr.

Cockle.

[*Cardium*, heart-shaped; *Islandicum*, Icelandic].

DISTRIBUTION. (a) *General*;—Near low-water mark to fifty fathoms. Cape Cod to Greenland, and circumpolar. Northern Europe, Behring's Straits, Japan.

(b) *In Acadia*;—(in N. B.) Grand Manan, twenty to forty fathoms, mud, *Stimpson*. Rather abundant in sheltered places, also found in Friar's Cove. (In N. S.) Annapolis Basin, rare, *Verkrüzen*. Halifax Harbor, *Willis and Jones*. Not reported from Prince Edward Island nor southern part of the Gulf. Probably occurs in mud and fine sand in many places in the Bay of Fundy and on the Atlantic coast of Nova Scotia.

HABITS. This is a very well-marked species, and, except in its young stages, cannot be confounded with any other on our coast. The valves are of a rounded form, and very convex or much hollowed out. On each, radiating fan-like from near the hinge, are about thirty-six raised angular ribs, which, on the free edge, give the shell a scalloped or crenulated appearance. The epidermis frequently rises into a bristly fringe on their summits, especially in young specimens, and this, with

the fact that the summits are angular, will distinguish the young of this species from *Cardium pinnulatum* which has flattened ribs bearing scales, and no such epidermis. It is in our waters from two to two and one-half inches long and nearly as broad.

Of its habits, very little is known. It lives partly buried in mud or fine sand under a few fathoms of water. It must feed altogether

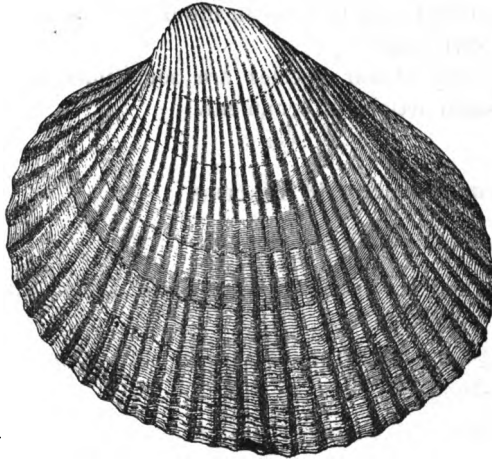


FIG. 14.—*Cardium Islandicum*. Natural Size.

upon microscopic organisms, plants and perhaps animals. It would probably have to be taken in a dredge of large mesh—so constructed as to allow the mud and gravel, etc., to pass through. It could probably be cultivated in our waters.

ECONOMICS. This species is never, so far as we have been able to learn, been eaten in America. It is inserted in this paper on account of its close relationship to the edible Cockle (*Cardium edule*) of Europe; without doubt it is edible, and is probably as good food as the European form, which it resembles closely in nearly all respects. The chief distinguishing mark between the two to the non-scientific observer is the smaller number of ribs, twenty-six, in *Cardium edule*, *C. Islandicum* having thirty-six.

The European Cockle lives on sand beaches and the banks of estuaries. We are told in the Fisheries Exhibition Literature that "It is equally good, raw or cooked, and may be

eaten in almost any numbers with impunity. It may be boiled or roasted, eaten alone, or as a sauce to fish." It is gathered all the year round and sells for five pounds a ton. So important is the fishery in England, that two bays alone produce £35,000 worth of Cockles a year, Morecambe Bay alone producing £20,000 worth annually. In view of these facts it is well for us to keep in mind that we have a Cockle upon our own coast.*

The shells of our species are sometimes employed for making small articles of ornament.

19. *Venus mercenaria* Linnæus.

Mercenaria violacea Schum.

Quahog or Quahang, Hard Clam, Round Clam, Little-neck Clam.

Mic-mac, Boogunumowas-uk. *Acadian French*, Pal-lude (?).

[*Venus*, *Venus*; *mercenaria*, used in trade].

DISTRIBUTION. (a) *General*;—In shallow water. Florida to Massachusetts Bay. Casco Bay and Gulf of St. Lawrence. Has been introduced into Europe.

(b) *In Acadia*;—(in N. B.) Caraquette, *Bell*. Bay Chaleur, Shediac, *Whiteaves*. (In N. S.) Halifax, Sable Island and Fishing Banks, *Gould* (on authority of *Willis*). St. Mary's Bay, "pretty abundant," *Verkrüzen*. Whole coast, common, *Jones*. Prince Edward Island, *Dawson*. It

* As this paper is passing through the press, the following appears in a Boston newspaper, too late for its insertion in its proper place.

"NEW INDUSTRY.—Manchester-by-the-Sea, June 23. A new industry has recently started in Manchester. The scarcity of bait has led the fishermen to bait their trawls with Cockles and they prove much better than herring, as dogfish will not touch them, and, as they are tough, they will hold on the hooks much better. It is not uncommon to see from twenty to thirty men on the flats picking Cockles and from fifty to seventy-five buckets are secured at each tide."—*Boston Record*, June 24th, 1889.

Through the kindness of Mr. Andrew Lee, 2nd, of Manchester, the writer received specimens of these "Cockles," which proved to be not *Cardium*, but simply *Buccinum undatum* and *Lunatia heros*.

is evidently common in the Gulf of St. Lawrence, from Bay Chaleur to Cape Breton. It seems strange, however, that it should be reported as being common all around the coast of Nova Scotia, when it is totally unknown upon the Bay of Fundy coast of New Brunswick. It is probably to be found wherever the Oyster lives, and being somewhat more hardy, occurs rather beyond those limits.

HABITS. This species is well-known to all oystermen and frequenters of fish-markets. It is a bivalve shell, having two very thick and heavy valves of a dingy white or ash color. Upon these are well

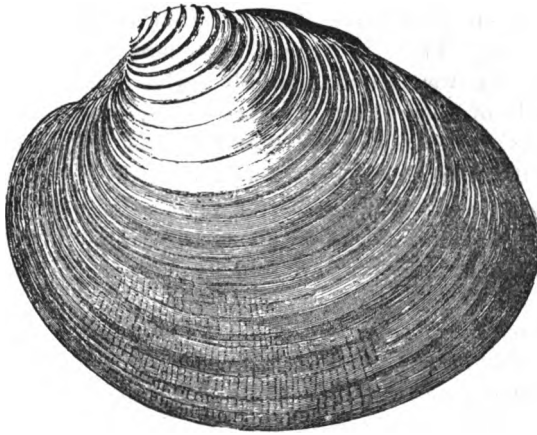


FIG. 15.—*Venus mercenaria*. Natural Size.

marked, very regular, concentric folds, which become quite sharp where not worn by friction. Inside they are chalky white, except at the smaller end, where they are usually of a beautiful purple. The margin is finely crenulated around three-fourths of its circumference. The shell is roughly heart-shaped in outline, about three and one-half inches long when full grown, and two and three-quarter inches high. These characters will distinguish it from any other form found upon our coast. The purple color is wanting in young shells, quite variable in amount in others, and is often covered by a thick white glazing in very old ones, while in certain cases it is wanting altogether.

Of its mode of life, Prof. Verrill says,—“Common on sandy shores, living chiefly on the sandy and muddy flats, just beyond low-water mark, but is often found on the portion laid bare at low water of spring

tides. It often inhabits the estuaries, where it most abounds. It burrows a short distance below the surface, but is often found crawling at the surface, with the shell partly exposed. It has short siphon tubes, united from the base to near the ends, and a large, muscular foot, with a broad thin edge, by means of which it can easily burrow beneath the sand when necessary." It clearly occupies much the same localities as the Oysters upon our North Shore, as it is along with them that it is usually taken. As it lives upon or very near the surface, it can be captured by raking or dredging, just as Oysters are; in the United States it is taken either by long-handled tongs or by the dredge.

ECONOMICS. In the United States this species ranks next to the Oyster as an article of food. Its annual value was estimated in 1883 to be \$657,747, that of the Oyster being \$13,439,000. These figures will show how valuable a Mollusc of our waters we are almost totally neglecting.

South of New York this is the common Clam of the markets. Between New York and Boston, this and the soft Clam, *Mya arenaria*, occur about equally in the markets, while north of Boston, the latter replaces the former. The best sell in New York for about three dollars per barrel, wholesale. Smaller ones are sold for sixty cents to one dollar per bushel. The smallest are used chiefly for pickling. They are taken from small boats by raking. It is also extensively used as bait. It sometimes contains pearls of white, blue, purple, violet or mixed colors, but they are rarely clear enough to be of any value.

This species has been introduced into several places in Europe, sometimes successfully, sometimes not. It has been acclimatized in the Dee, and, perhaps, also on the Cheshire coast, and at Bordeaux, in France, but at least one attempt to make it live at Arcachon, in the south of France, has failed. These efforts to introduce it into Europe show how highly it is valued by people who have it not in their own waters, and they should have a lesson for us who value it little though abundant on our own shores.

In Acadian waters we cannot find that it is ever fished for separately. It is taken with Oysters and sold along with them. In St. John it is rarely or never sold separately, though in Halifax, where a few bushels a year are disposed

of, it is sometimes sold by itself. Some persons consider it poor food, but its great use in the United States proves beyond question that it must be on the whole an exceedingly good food-mollusc.

This species has an interest for us also, from the fact that the purple part of its shell furnished the material for the purple wampum of the eastern Indians. White wampum, as has been mentioned (p. 12), was made chiefly from the columellæ or central columns of the two species of *Busycon* (also known as *Fulgur* and *Sycotypus*, and sometimes *Pyrula*). The purple was worth twice as much as the white, and both were made in the form of tube-shaped beads, perforated and polished; their value depended upon their polish and general perfection. It was a real currency among the Indians, true money, and, as one old writer says,—“their mammon.” It was the chief medium of trade between the whites and Indians along the southern New England coast. The former, however, took to manufacturing it themselves, and this naturally led to depreciation of value and many abuses. Laws were passed regulating its use in trade, and it continued to be manufactured until within about fifty years, for use in the west. A very full and interesting discussion of this whole subject may be found in the first of the works mentioned below.

Among the Canadian Indians it was very extensively used. Early explorers (including Cartier) refer to it, and Kalm, the Swedish botanist and traveller, saw it in the middle of the last century among the Hurons and below Québec. Charlevoix, in his letters (London, 1763), refers to “Wampum from the Venus shell,” (p. 132) and gives a most interesting description of it. It was very highly valued by the Indians of Acadia, as Lescarbot tells us,* but was used by them for ornament rather than for money. It was also used by the Acadian Indians as well as by those of the south and west, as a sort of record of events, treaties, etc. Gesner tells that the Mic-macs had wampum records, and Charles Leland, in his “Algonquin Legends,” mentions that the Passamaquoddys have wampum records at Pleasant Point, Maine, which

* See introductory part of this paper, p. 13.

can be read at present by only a single Indian. The only other evidence of its use in Acadia that the writer has been able to find, occurs in a paper by Professor L. W. Bailey, in No. VI. of this Society's Bulletin, entitled, "On the Relics of the Stone Age in New Brunswick." He mentions that some shell beads were found with the bones of a child upon the Tobique River. He says,—“They would appear to have been derived from the common fresh water Clams (*Unio* and *Anodonta*), and, considering the circumstances under which they were found, were probably of true Indian and domestic manufacture, rather than imported or imitative products, such as were abundantly made for purposes of barter, in more thickly settled localities.”

The Molluscs, from the shells of which white wampum was chiefly made, are entirely wanting upon the shores of Acadia, though that from which the purple was made, viz.: the species we are now considering, was abundant; yet Lescarbot gives us to understand that neither kind was made in Acadia. He did not know, however, from what the purple wampum was made; he supposed it was from jet or a kind of wood. The Quahog must have been extensively used by them as food, and it seems strange that they should not have learned from the tribes to the south to make it themselves.

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 Aboriginal Shell-money. By R. E. C. Stearns. Proc. Cal. Academy, Vol. V., pp. 113-120. Also American Naturalist, Vol. III., 1869, pp. 1-5.
 Fishery for Quahogs. Fishery Industries of the U. S. Sec. V., Vol. II., pp. 595-613.

20. *Cyprina Islandica* (Lister) Lamarck.

Black Quahog.

[*Cyprina*, from Kupris, a name of Venus; *Islandica*, Icelandic].

DISTRIBUTION. (a) *General*.—Shallow water to ninety fathoms. Long Island to Arctic Ocean, and around the

North Atlantic to Northern Europe, Great Britain and Portugal.

(b) *In Acadia*;—(in N. B.) Grand Manan, rarely found, *Stimpson*. Bay of Fundy, six to ninety fathoms, *Verrill*. Passamaquoddy Bay, *Ganong*. Northumberland Straits, *Whiteaves*. (In N. S.) Halifax Harbor, common, *Jones*. Annapolis Basin, St. Mary's Bay, not abundant, *Verkrüzen*. (In P. E. I.) Not specially reported, but doubtless occurs. Probably to be found on mud and sand bottoms all around the coast.

HABITS. This is one of the two or three Molluscs popularly included under the name Quahog—*Venus mercenaria* being the true Quahog. In general appearance these two shells are much alike, their

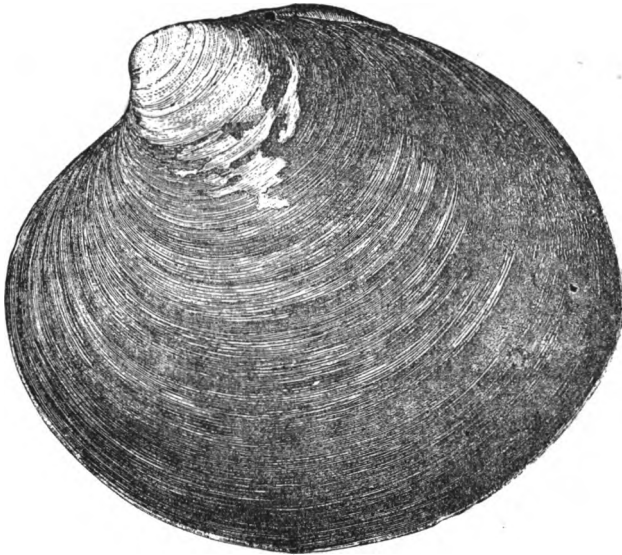


FIG. 16.—*Cyprina Islandica*. Natural Size.

shape, especially, being very similar. But they may always be distinguished by their color, which, in the latter, is ashy or chalky-white, while in the former, if the epidermis is present (as it nearly always is) it is a dark burnt-brown, or nearly black color. This species wants the purple color of the interior of *V. mercenaria*, and differs from it also in

being larger and more nearly circular in outline. The young have the epidermis lighter in color—a light, yellowish horn-color. It is three and one-half to four inches long and nearly as high.

It is never found living where it can be exposed even by the lowest tides, and hence, can be taken only by dredging or when cast up by the waves. It seems to prefer mud bottoms, and Gould says,—“is most frequent near where some river empties into the ocean.” It does not live very deeply buried, as it is frequently cast up on beaches in great numbers by the waves after a storm.

ECONOMICS. A useful and good food-mollusc, and frequently eaten along with *Venus mercenaria*, from which it is not usually distinguished except by large dealers. It is said by good judges to be of very good flavor. Willis says it is considered excellent food in Nova Scotia. The writer has seen, at Lynn Beach, Massachusetts, dozens of men collecting this species which had been cast up in great numbers after a heavy storm. Many of them were shelled upon the spot, while the rest were carted away to Lynn. They seemed to be highly esteemed by those who were taking them. We do not know whether or not they are ever cast up in numbers upon our own shores, but they are taken not infrequently in dredging. They are neither abundant enough nor easily enough obtained to make it pay to take them for market. We cannot find that they are ever sold by themselves in our towns. They are a food of Cod and perhaps other fishes.

21. ***Mactra solidissima*** Chemnitz.

Mactra gigantea [of Willis].

Spisula solidissima Gray.

Sea-clam, Giant-clam, Hen-clam, Beach-clam, Surf-clam.

[*Mactra*, a kneading-trough; *solidissima*, very solid].

DISTRIBUTION. (a) *General*.—Low-water mark to ten fathoms. Florida and Gulf of Mexico to Labrador.

(b) *In Acadia*.—(in N. B.) Grand Manan, *Stimpson*. Bay of Fundy, low-water mark to ten fathoms, *Verrill*. Passamaquoddy Bay, large and abundant, *Ganong*. Shediac, Point du Chene, *Whiteaves*. (In N. S.) St. Mary's Bay, very

large, *Verkrüzen*. Mahone Bay, St. Margaret's Bay, Sable Island, *Willis*. Sandy beaches, whole coast, *Jones*. Prince Edward Island, *Dawson*. Probably occurs in sandy situations where there is clear water around the whole coast of the three provinces.

HABITS. When fully grown this is the largest shell upon our coast. From the common Clam it is distinguished by its greater size and proportionally greater weight, as well as by its shape. Unlike the latter, its sides slope directly away from the hinge so as to give it a rounded-triangular shape. When young it is covered with a dull-brown or straw-

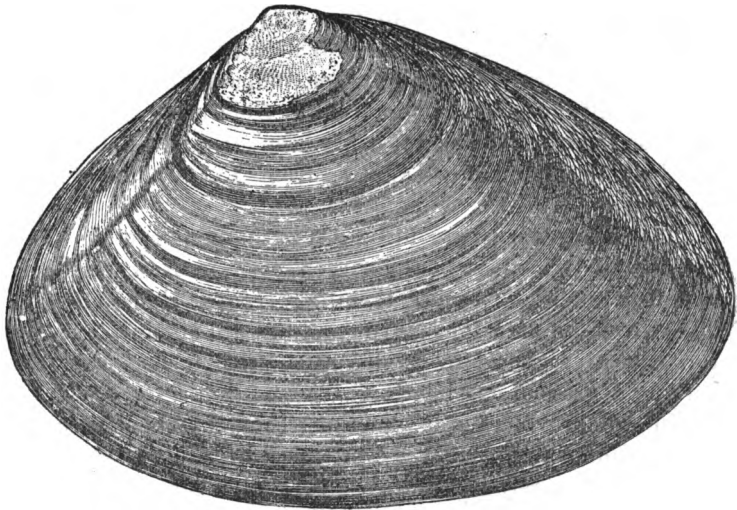


FIG. 17.—*Mactra solidissima*. Two-thirds of Natural Size.

colored epidermis, which becomes mostly worn off in old specimens, and is entirely absent in those cast up by the waves. Large specimens are six inches in length, but J. Matthew Jones mentions a specimen from Sable Island seven and one-fourth inches long and six and one-half in breadth, and Willis gives them even a larger size.

It lives only in sand, and in situations where the water is clear. It burrows like the common Clam, but not deeply and does not form permanent burrows as does the latter. It is only uncovered at the lowest tides.

ECONOMICS. It is used for food and is also put up for bait. Gould says it "is much esteemed by some as an article-

of food, but it is apt to induce severe pain," while Ingersoll says it is by some considered unwholesome. Willis, however, states that it is considered a wholesome and nutritious article of food. Prof. Verrill writes that in large specimens the meat is usually tough, but the younger ones are quite as good as either the hard or soft Clam (*V. mercenaria* or *M. arenaria*). It is eaten by the fishermen of the Atlantic coast of the United States. They dig it with shovels at lowest tides, but those beyond reach of this method are taken by sharp sticks which are thrust between their valves by men wading. The latter keep pushing the stick into the sand and when it passes between the open valves of an animal they close upon it and the animal is easily drawn up. Its comparative scarcity and the difficulty of getting it prevent it from being of as much value as the other Clams, yet it has been estimated to be worth for bait in the United States, from \$30,000 to \$40,000 annually.*

The heavy shells are utilized for many purposes. The Indians used them as hoes for their corn in New England, and fishermen's wives use them for scoops, skimmers, etc. They are often used for painting on, and are not infrequently for sale in seaport towns decorated with marine views of varying degrees of excellence.

In our Provinces it is sometimes eaten by the fishermen, but we cannot find that it is ever exposed for sale in the markets, except rarely in Halifax. Verkrüzen states that it is eaten at St. Mary's Bay, Nova Scotia, and the fishermen on the Charlotte County coast occasionally eat it. It would be used more, no doubt, could it be more easily obtained.

22. *Mactra ovalis* Gould.

Mactra ponderosa Stimp.

Mactra solidissima [of Willis].†

[*Mactra*, a kneading-trough; *ovalis*, oval].

*Another estimate gives its value as \$7,500 annually.

†The writer has not seen Mr. Willis' annotated list of Nova Scotia Mollusca, but from the list of edible forms, copied by Knight, he appears to mean what we call *M. ovalis* when he mentions *M. solidissima*.

DISTRIBUTION. (a) *General*;—Low-water mark to ten fathoms or more. Cape Cod to Labrador.

(b) *In Acadia*;—(in N. B.) Grand Manan, common in sand at low water, buried at a depth of four inches, *Stimpson*, *Verrill*. (In N. S.) Annapolis Basin, St. Mary's Bay, rare, *Verkrüzen*. Chester, Lunenburg, Mahone Bay, River John, *Willis*. Not reported from Prince Edward Island. Having been reported from so few places, it is impossible to state its distribution on our coasts.

HABITS. Similar to the last species, *M. solidissima*, in habits, and very like it in appearance. It is smaller, rarely exceeding four inches in length, but it is never distinguished from it by fishermen. The chief mark by which *M. solidissima* may be separated from it, is the presence of striations on the long hinge teeth, *M. ovalis* having none of these. It is much less common than *M. solidissima*, and is a more northern shell.

ECONOMICS. Probably it can be used for the same purposes as *M. solidissima*, though its smaller size and greater scarcity must render it less valuable. Mr. Willis says, referring to this species, that it "sometimes finds its way to Halifax market, and is readily disposed of."

23. *Mya arenaria* Linnæus.

Clam, Soft Clam, Long Clam, Sand Clam.

Mic-mac, Aas-uk. *Passamaquoddy*, Ess-sook (or Hess.) *Acadian French*, Cocque.

[*Mya*, perhaps *mus* of the ancients; *arenaria*, living in sand].

DISTRIBUTION. (a) *General*;—Between tide-marks to more than one hundred fathoms. South Carolina to the Arctic Ocean. Northern Europe and south to England and France. Northeastern coast of Asia to China and Japan. Sitka, Alaska.

(b) *In Acadia*;—(in N. B.) Abundant everywhere in sand and mud on the southern coast from Grand Manan to St. John and probably much further. Bay Chaleur, *Bell*. Shediac, *Whiteaves*. (In N. S.) Annapolis Basin and Bay of Fundy, common, *Verkrüzen*. Halifax Harbour, etc., very common,

Jones. Prince Edward Island, common and large, *Dawson.* Abundant on every sand bar, *J. H. Duvar.* Undoubtedly one of the most common of Molluscs around the entire coast of Acadia.

HABITS. No reader of this paper can require a description of this species to enable him to identify the Clam. Who does not know this most ubiquitous of Molluscs? But not so many, perhaps, have acquaintance with its habits.

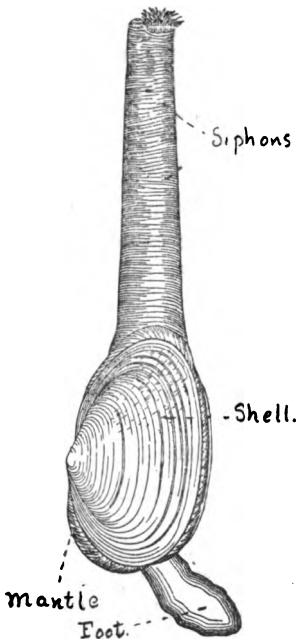


FIG. 18.—*Mya arenaria*.
One-half natural size.

Upon every mud or sand beach around the sea-coast of Acadia, the visitor will see very many round holes, half an inch in diameter, from which, as he walks near them, streams of water are frequently forcibly ejected. At the bottoms of these, at a depth of from six inches to over a foot, according to locality and character of the soil, the Clams are to be found, standing upright at the bottoms of their burrows, for such they are. Yet it does not properly stand upright in the sense that a man does, for it stands head downwards, the tough, black, protruding part, commonly called the head, not being that organ at all. If this black part be dissected, it will be found to consist of two tubes, the "siphons," bound together, with thick, tough walls, both leading into the general cavity of the animal in which all of the internal organs lie. The only other opening into the animal's body is a small one at the opposite end which allows the animal to thrust out its muscular, extensible "foot." It is by the use of this foot that it can move up and down in its burrow, within certain limits, or form a new one if necessary.

If a Clam be placed upright in some sand at the bottom of a glass vessel of salt water it will need only careful watching, with perhaps a little experimenting, to show that there is a current flowing into one of the tubes—that away from the hinge side and the larger—and a current out of the other, or the smaller one towards the hinge side. The dissection of another specimen will show the internal organs in position,

and it may then be seen that the entering water must bathe the four great, flat gills as it passes downwards towards the mouth. These gills subserve the same function as do those of fishes, for in them the blood of the animal receives its needful oxygen and gives off its useless gases. Near the extreme anterior (though lower) end, guarded by four long ear-like flaps, is the minute mouth, and into it are guided by the flaps the minute animals, plants and crustacea upon which it feeds. The water, now robbed of its oxygen and food materials, passes along the back or hinge side, taking up useless matters given off by the animal and passes out through the other tube. These tubes have the power of great extension, so that when their owner is safe deep in its burrow, it can push them up to the surface and get clear, pure water. At low water, when the flats are exposed, it retains water enough to last until the tide covers it again, when, doubtless hungry enough, it keeps up an active in and out circulation of water. If it is incautious enough to come to the surface, it is likely to be snapped up by some fish, for many of this tribe dearly love the Clam. It also lives under many fathoms of water, where its habits are probably the same. Its time of reproduction has not been studied carefully in our waters, but probably does not differ greatly from that of the same species farther south. Mr. Ryder (see paper referred to below) finds that they give out their eggs from the tenth of September to the middle of October. The young are without shells and can swim freely about for a time, a provision to allow them to be removed from the vicinity of their parents, and so to prevent overcrowding. They soon settle to a sand or mud bottom and as they develop the shell, burrow beneath the surface. They grow to a length of from one to two inches in seven months, these lengths being exclusive of the tubes. The artificial raising of the young is considered very difficult, though they may be transplanted readily to new beds.

ECONOMICS. This species has two very important uses—as human food and as bait in the fisheries. For the latter purpose it is very extensively used in Acadia, and also in the United States. Exact statistics of the quantity used for bait alone are wanting in the latter country, and the Dominion Fishery Returns probably give but an imperfect idea of the quantity used in the former. Nova Scotia is the only one of the Maritime Provinces which gives figures in the reports, which for the years from 1884 to 1887 are as follows:

	1884	750 barrels @ \$7=	\$5,250
	1885	1136 “ 5	5,680
	1886	970 “ 5	4,850 + (\$100 worth used) as food.
7	1887	475 “ 7	3,325

These are taken chiefly in Queens and Halifax Counties. No doubt the rapid diminution in quantity since 1885 is due to the greatly increased use of the Squid [which see] since that time. It is shelled and salted for long voyages, but carried alive to the fishing grounds when the latter are near home. Willis tells us that "It is said to be an irresistible bait to both haddock and codfish." Mr. J. H. Duvar states in his Report for 1880, and subsequently has informed the writer, that they were formerly much used in Prince Edward Island for mackerel bait and were gathered by the Acadian French who sold them to the fishermen for fourteen to fifteen cents per quart, shelled. Their use is now almost superseded by that of chopped herring. It is used in Gaspé and Quebec even more extensively than in Acadia.

As an article of human food, it is much more used in the United States than with us. North of Cape Cod it is the common Clam of the markets; south of New York it is replaced by the Quahog, *Venus mercenaria*; while between those places, both are found in about equal quantities. The very best come from Guilford, Conn., and sell for about three dollars per hundred. At this place a few of extraordinary size are found at lowest tides, the shells being six or eight inches long, and the animal of good flavor. These sell for about one dollar and twenty-five cents per dozen, the price for ordinary sizes being from ninety cents to two dollars per bushel, wholesale. The latter retail in the markets for from fifty to seventy-five cents per peck, according to size. In New Haven they are sold only in winter, and considered out of season in summer, though in New York they are sold throughout the year. A system of cultivation has been tried with good results. The total annual value to the United States of this species, including the large quantities collected for bait on the New England coast, is, according to the census of 1880, about \$330,500. \$562,376 according to another report. It has, however, been estimated by Mr. Earll, of the U. S. Fish Commission, in a speech made at the London Fisheries Exhibition of 1883, to be as high as \$600,000 annually. These figures do not include those taken on

the Pacific coast, to which it has been recently introduced and where it is spreading rapidly. It is sometimes taken by a system of ploughing, but rarely; the ordinary weapons for capturing it, are there, as with us, a simple bucket and shovel.

In England this species is used neither for bait nor for food, except very locally, being replaced entirely for both purposes by the edible Mussel, *Mytilus edulis*. This seems to us very remarkable and unaccountable, considering to what an extent other Mollusca are utilized there. It must be remembered that in England this is called the "Gaper," the name Clam being applied to a species of Scallop, *Pecten opercularis*.

In Acadia no statistics are available to show the annual value to the three Provinces of this species as food. The returns in the Annual Fishery Reports give the value of Clams as bait or else overlook them altogether. By the fishermen and the people of the sea-port towns it is quite extensively eaten in New Brunswick, and it is frequently for sale in the markets. In St. John, Mr. J. A. Turner estimates there are one thousand barrels per year sold, at an average price of one dollar and fifty cents per barrel, wholesale. The largest and best for city trade are brought from Lepreau.

In Nova Scotia it is very extensively used as food. Willis says it could be bought in the Halifax market for a shilling sterling per bushel in the shell, or for about threepence per quart shelled. At present, over three hundred barrels a year are sold, the most of which are brought from Cole Harbor and Chezzetcook. They sell for about ten cents a quart or six dollars per barrel shelled.

In Prince Edward Island it is very little used as food, being eaten only by the Acadian French, according to Mr. J. H. Duvar. It is not improbable that some very large individuals may be found in favorable situations, such as those referred to above, from Guilford, Conn. Certainly the sandy shores and warm summer temperature of the water ought to favor their growth to a large size.

In the vicinity of the St. Croix River, "Clam-bakes" are an institution of venerable antiquity. The Indians probably had

them, and congenial spirits from the border towns still delight to return at times to the ways of their Clam-loving predecessors. On some favored spot on the shores of that splendid river they assemble by appointment ; a great fire is built and by it many stones are heated and made very hot. The embers are then raked aside and upon the stones is placed a layer of wet seaweed, on which a layer of Clams is laid. Then comes another layer of sea-weed and another of Clams, and so on, the top of the whole being a cushion of sea-weed of extra thickness. Over the whole mass is perhaps a piece of canvas thrown, and in such an oven are the Clams slowly steamed to the proper degree of deliciousness. A constant concomitant and the most pleasing feature of these banquets is the invariable good-nature and good-fellowship which prevails.

The great heaps of shells on the Charlotte County coast, made as we know by the Indians, show of how much importance this species was to them. It doubtless formed the bulk of their food during the summer, when large game was out of condition, and possibly, as Mr. Matthew has shown, to some extent in winter also. The heaps are sometimes two or more feet deep, and cover several acres. It was probably used quite extensively by them in Nova Scotia and Prince Edward Island also, but as yet the shell-heaps of those Provinces have received but little attention and we hardly know anything of their number, extent or contents.

Clams as well as Oysters are sometimes found, in which a considerable portion of the edible part is of a green or bluish-green color. This has been repeatedly shown by chemists to be non-metallic and perfectly harmless, though some think they have a coppery taste. The color is due to the nature of the food, being produced when they feed upon certain diatoms or minute plants (chiefly *Navicula ostrearia*, var. *fusiformis*). Experiments show that the green color can be artificially produced by feeding them upon these diatoms, and that it will disappear in a few days when they are changed to other diet. The green Clams may be eaten with perfect confidence.

WORKS OF REFERENCE.

- The Oyster, Clam, and other Common Mollusks. By Alpheus Hyatt. Boston, 1884, 12mo., 65 pp., many figures.
- On the Rate of Growth of the Common Clam, etc. By John A. Ryder. Bulletin U. S. Fish Commission, Vol. V., 1885, pp. 174-176.
- On the Green Coloration of the Gills and Palps of the Clam (*Mya arenaria*). By John A. Ryder. Bull. U. S. Fish Commission, Vol. V., 1885, pp. 181-185.
- The Clam Fisheries. Fishery Industries of the U. S., Sect. V., Vol. II., pp. 581-594.

24. *Mya truncata* Linnæus.

[*Mya*, perhaps the ancient *mus*; *truncata*, cut short.]

British Gaper.

DISTRIBUTION. (a) *General*.—Low-water mark to below one hundred fathoms. Cape Cod to Greenland. North European seas to Great Britain.

(b) *In Acadia*.—(in N. B.) Grand Manan, low-water mark, *Stimpson*. Shediac, *Whiteaves*. Not abundant on the southern coast. (In N. S.) Halifax Harbor, not uncommon, *Jones*. Not reported from Prince Edward Island. Probably not abundant on our coast.

HABITS. This species may be distinguished from the common Clam (*Mya arenaria*), by the shape of the valves, for in it the posterior end, or end from which the tubes protude, is cut sharply off, as its name signifies, and is not evenly rounded as in *Mya arenaria*. The posterior end also, even when the shell is closed, gapes widely open, instead of only slightly as in *Mya arenaria*; whence comes the name, given above, by which it is known in England. The epidermis is prolonged into a tube posteriorly helping to give the protection which is lost by the truncation of the shell. It is from two to three inches in length. In its habits it is not known to differ essentially from *Mya arenaria*.

ECONOMICS. It is probable that this species is often dug with and used for the same purposes as *Mya arenaria*. Indeed, as both are variable in form they frequently are much alike, and it is not probable that they are ever separated by the

fishermen. They are both useful for the same purposes — bait and food. Forbes and Hanley tell us that it is eaten both in Britain and North America. It is more common in England than *Mya arenaria*, but the reverse is certainly the case with us. It is an important article of food to the Cod, being found in their stomachs in great numbers, especially on the Newfoundland Banks.

25. *Solen ensis* Linnæus.

Var. *Americana* Gould.

Ensatella Americana Verrill.

Razor-shell, Razor-fish, Long Clam, Knife-handle.

Mic-mac, Sasabegwit, pl. Sasabegwidul.

[*Solen*, the ancient name; *ensis*, a kind of sword, a scimitar.]

DISTRIBUTION. (a) *General*;—Low-water mark to twenty fathoms. Florida to Labrador.

(b) *In Acadia*;—(in N. B.) Grand Manan, at low water, in sand, rare, *Stimpson*. Eastport, *Gould*. Bay of Fundy, *Verrill*. Passamaquoddy Bay, *Ganong*. Shediac, *Whiteaves*. (In N. S.) Sandy shores, whole coast, *Jones*. St. Mary's Bay, *Verkrüzen*. (In P. E. I.) Common in Northumberland Straits, *Dawson*. Probably to be found everywhere on the shores of Acadia where there is sand and clear water, though nowhere very abundant.

HABITS. We have upon our shores no Mollusco so strikingly distinct from all others as this. Its parallel slightly curving sides and squarely truncated ends are found in no other of our shells, and they give it a shape which fully justifies the names of "Razor-shell" and "Knife-handle," by which it is commonly known. It grows to a length of about six inches, though eight inches is not unknown. The young animal is covered with a shining greenish-yellow epidermis, which partly disappears in old shells, leaving the latter a dull chalky white. At one end (the posterior) project slightly two short fringed tubes — united below their tips. At the other (anterior) end projects the powerful "foot" by which the animal is enabled to burrow so rapidly in the sand. These burrows are found only near extreme low-water mark. They are two to three feet deep, and so rapidly can the animals travel down them that

a man cannot dig quickly enough in the sand to catch them. Frequently at low water they may be found at the surface, with about an inch of the shell projecting, but if not approached quietly and seized quickly they are soon out of reach. A method of catching Razor-shells, frequently practiced in England, is to drop a little salt in the burrow, adding a little water to carry it down. This is literally putting salt on their tails, for they stand head downwards in their burrows. The irritated animal always comes to the surface and can be seized by the hand. Another method is to push down the burrow a stout wire, having at its end a barb or hook; this pierces the animal and it can be easily drawn up. Both of these methods would certainly work with our species.

These animals, like most others which cannot move about, feed on microscopic plants and animals, which are drawn into their bodies with water by one of the fringed tubes, the other being for the removal of waste matters. They are rather fastidious in their habitat, requiring clean sand and clear water. They are, hence, not found on rocky shores nor in estuaries. They are eaten by some fishes, principally by the Skates.

ECONOMICS. Of Razor-fishes in general, Forbes and Hanley tell us,—“They are among the most delicious of shell-fish when properly cooked—broiling is the best method.” Willis says our species is an excellent article of food, and they have been sold in the Halifax market for one penny each. Mr. J. H. Duvar remarks that when offered for sale at rare intervals in Halifax, they have found purchasers among epicures. It seems to be entirely unknown as an article of

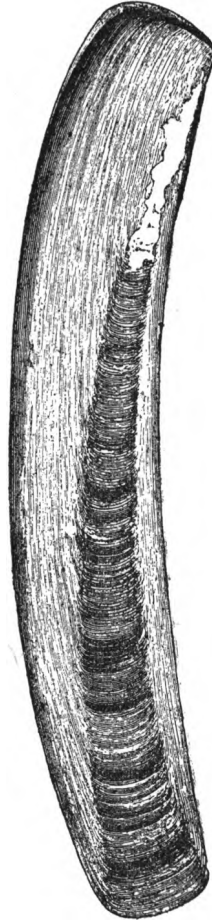


FIG. 19.—*Solen ensis*, var. *Americana*.
Natural Size.

food in St. John or Prince Edward Island. The fishermen of the Charlotte County coast, and of parts of Nova Scotia, know and esteem them, and the same may be true of the fishermen of other parts of Acadia. The shells are used for some ornamental purposes.

All testimony goes to show that it is an excellent food Mollusc, but its comparative scarcity and the difficulty of obtaining it will prevent its extensive use.

WORK OF REFERENCE.

Fishery Industries of the U. S. Sect. V., Vol. II., pp. 613-615.



FIG. 20.—*Solen ensis*, var. *Americana*, Half Natural Size.
S., Siphons; Sh., Shell; M., Mantle; F., Foot.

26. *Zirphæa crispata* (Linn.) Mörch.

[*Zirphæa*,—(?); *crispata*, wrinkled.]

Date-fish.

DISTRIBUTION. (a) *General*.—Shallow water to seventy fathoms. Connecticut to Gulf of St. Lawrence. Iceland. Northern Europe to Great Britain and France. West coast of America, south to California.

(b) *In Acadia*.—(in N. B.) Grand Manan, very rare, *Stimpson*. Bay of Fundy, eight to seventy fathoms, in hard clay, *Verrill*. L'Etang Harbor. (In N. S.) Sable Island, large specimens, *Jones* (on authority of *Willis*). Prince Edward Island, boring in red sandstone reefs, *Dawson*. Probably to be found in suitable localities all around our coast.

HABITS. This is a well-marked shell and not like any other yet found on our coast. It is a bivalve, each valve of which is somewhat like that of the Clam. Across the middle runs a furrow, in front of which the lines of growth rise in regular teeth, which are entirely wanting behind that line. The shell gapes very widely open both before and behind, and the dorsal margin in front of the furrow is folded over outwards. It does not exceed four inches in length in our waters, but

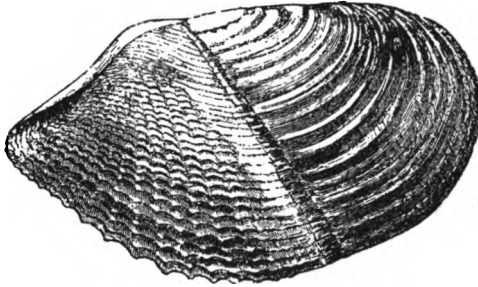


FIG. 21.—*Zirphæa crispata*. Natural Size.

grows much larger to the south and on the west coast. It is a burrowing Mollusc, and lives in hard clay, soft stone or even submerged wood.

ECONOMICS. On the coast of California this species is extensively eaten. It is, however, much larger than with us, and is regularly exposed in the markets under the name of "Date-fish." It is not abundant enough in Acadia to be of any value. It appears to do no injury in its burrowing, to any of man's works.

27. *Teredo navalis* Linnæus.

[*Teredo*, a borer; *navalis*, infesting ships.]

Ship-worm.

DISTRIBUTION. (a) *General*;—In submerged timber. Gulf of Mexico to Vineyard Sound. Gulf of St. Lawrence, abundant. [Massachusetts Bay to Chedabucto Bay, much less abundant]. Sweden and Great Britain to Sicily; Algeria and the Black Sea.

(b) *In Acadia*;—St. John, Shediac, Pictou, Whiteaves. Northumberland Straits, St. George's Bay, Strait of Canso,

Chedabucto Bay and all around Cape Breton, abundant and very destructive. Also around entire coast of Nova Scotia, but much less abundant and not troublesome, *Martin Murphy*.

[As the species of *Teredo* inhabiting our waters have not been well worked out, it is quite probable that there exists at the localities named above other species in addition to *T. navalis*. Indeed, Mr. Murphy, in the second of the papers quoted below, expressly states that *either T. navalis or T. Norvagica* exist all around the coast of Nova Scotia. It is greatly to be desired that a thorough study of our species should be made, and all are earnestly requested to assist in this work. Specimens from our waters, either of the animals preserved in alcohol, or of the wood containing their burrows and shells, would be of great value. They should be sent either to Mr. J. F. Whiteaves, of the Dominion Geological Survey, or to the writer.

Teredo navalis prefers water warmer than that of the Bay of Fundy and the Atlantic coast; and hence we find it, though present, not at all troublesome in these waters. Its range, where destructive, on the other hand, is nearly coincident with that of the southern fauna of the Gulf of St. Lawrence. Mr. Murphy, in his admirable paper on the *Teredo* in Nova Scotia, cited below, misses the explanation of this fact. It is not because these waters are ice-bound in winter that it exists there, but because their warmer summer temperature affords more favorable conditions for the development of its young.]

HABITS. It is difficult to distinguish between the different species of *Teredo*, of which more than twenty are known, but the group or genus, as a whole, is easily recognizable. While differing somewhat in detail, their habits and structure are in general similar, and a description of one will answer with but few modifications for all.

Teredo navalis is the best known of all of the species on account of its great damage to fixed and floating timber works in Europe, particularly the dykes and docks of Holland. It is by no means certain that it is the most common species in Acadia, but beyond all question it does occur on the Gulf of St. Lawrence coast.

In external appearance, the animal fully justifies its common name. But it is a true Mollusc, and a bivalve like the Clam. Though elongated and cylindrical, it shows no trace of constrictions. The anterior end,

that buried deepest in the wood, is the largest, and at its extremity bears the two valves, greatly reduced and forming the boring apparatus. Between them occurs the opening through which the slender "foot" can be protuded, an organ corresponding with the "foot" in the Clam. Except for this opening the mantle or "skin" of the animal is unbroken until the posterior end is reached, where the body terminates in two tubes or siphons, corresponding with those in the Clam. Probably one of these is for the admission of food and fresh water, and the other for the excretion of waste water and the wood which passes through the animal's body. These siphons can be retracted and the burrow quite closed by two little calcareous valves or pallets, borne near the siphons. The latter, when the animal is distended, are at or near the surface of the wood.

In burrowing, the *Teredo* generally follows the grain of the wood, but will cross it when necessary to avoid a knot, nail, neighbour's tube,

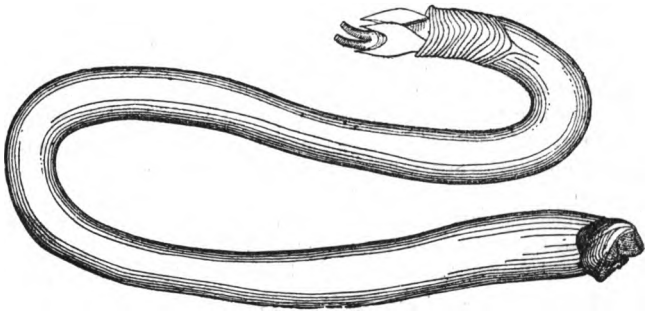


FIG. 22.— *Teredo navalis*. Twice Natural Size.

or other obstruction. They never pierce each other's tubes. As the latter are formed, they are lined by a calcareous layer, more or less thick, and firm enough to allow large pieces of it to be removed entire from the wood after the animal is dead. It is still doubtful what mechanism the animal employs in burrowing. Many naturalists think the valves, armed by numerous fine constantly growing teeth, form the apparatus, and that by them the animal eats, or rather files, its way onward. One observer states, that by breaking away the side of a burrow, he has actually seen this operation going on; others claim that the foot accomplishes the work, by the same unknown means by which certain limpets can excavate rocks. It is pretty generally agreed, however, that the *Teredos* do not get nourishment from the wood, but bore it simply to form a home. Their food consists of minute animals and plants, taken into the body through one of the siphons.

The time of breeding of this species differs somewhat with the locality, but it takes place generally in the spring or summer months. They are very prolific. The young at first can swim freely about, but in a very short time (one writer says four days) they are fully equipped for their life work, and attaching themselves to wood, begin to bore their tunnels. After entering the wood, they increase rapidly in size, so that the adult burrows are many times larger than those by which the young enter. It is thought that as a rule they do not live longer than a year or eighteen months. They require pure salt water, free from sediment, and cannot generally live in brackish or polluted situations. Their tubes are sometimes ten inches long, but generally not more than half that length.

A piece of *Teredo*-bored wood shows but little outward trace of the condition within. Except for the small holes made by the entering young, it may appear quite sound, when in reality riddled by the burrows and composed of almost nothing but their calcareous tubes.

Along with the *Teredo*, there is frequently found a small crustacean, *Limnoria lignorum*, which also forms burrows and is very destructive. They work, however, in different ways, for the latter attack only the surface of the wood, and honey-combing it so thoroughly that nothing is left but partitions between burrows, allow it to be easily destroyed by the waves. As the outside is removed, they progress deeper, and so rapidly do they work that an inch a year is frequently removed all around the largest submerged timbers. The minute size of the burrows, about one-sixteenth of an inch in diameter, and the absence of a calcareous lining, as well as the presence of the crustacean itself, will always distinguish its ravages from those of the *Teredo*. It largely replaces the latter on those parts of the shores of Acadia where the *Teredo* does little harm, *i. e.*, on the Atlantic Coast of Nova Scotia and around the Bay of Fundy, and it does great damage in these localities. It is particularly destructive at Digby. The *Teredo*, on the other hand, perforates the wood through and through, and makes it so fragile that it will break under a slight shock. It seems to have little preference in regard to the wood it attacks, the hardest and softest being equally injured. The southern palmetto is said to withstand it.

ECONOMICS. About the years 1730-32, great damage was done to the dykes of Holland by this *Teredo*. A general submergence of the country was threatened, and the consequent alarm led to the careful study of the habits and structure of the animal. Since then, it has appeared in numbers at different periods. In 1858 fresh alarm was caused, which resulted in the appointment of a commission to investigate the whole subject and experiment upon different methods for

withstanding its ravages. An account of the work of the commission, by one of its members, is given in the first of the papers whose titles are below.

The animals work with extreme rapidity. In San Francisco Bay, they have destroyed great timbers within eighteen months, and even in certain cases within six months. It is recorded also that in Chesapeake Bay they have perforated small timbers completely in six weeks. Ships have been riddled on their first voyages. It is impossible to calculate the enormous damage annually done by this and allied species to naval works in different parts of the world.

In our own waters much damage has been done at Pictou and other places on the North Shore; piles of wharves and bottoms of ships alike suffer. Mr. Murphy, in his admirable paper quoted below, says that at Sidney Harbor, Cape Breton, "the *Teredo* is seemingly as destructive, if not more so, than at any point on our coast." Mr. Whiteaves, in one of his reports, tells us that "Ship-worms of large size are said to be found at Halifax."

On the southern coast, their work is likely to be confounded with that of *Limnoria lignorum*, referred to above. It was probably the work of both together that completely destroyed within a period of six years a large and strong tide-dam at Frye's Island, Charlotte County, but it is the *Limnoria*, as Prof. Verrill points out, that does the damage to weir-posts in that region. In St. John harbor they do no damage. Mr. S. W. Kain tells the writer that piers do not need protection from *Teredo*, though *Limnoria* is somewhat injurious. Pieces of timber which have been under water for many years show no trace of the presence of the former, and ships which enter the harbor infested by them, are free from them within two days. It is generally believed that this is caused by the great amount of fresh water in the harbor. Mr. Kain says: "There seems to be a consensus of opinion among all shipping men that the *Teredo* is not found in the Harbor of St. John, nor in any harbor where there is any considerable body of fresh water." The cause assigned no doubt explains the killing of those which are brought into and their absence from the

Harbor, but does not account for their absence from the remainder of the Bay where clear salt water is found. No doubt the low temperature of the water in the summer months, making the conditions for their young so unfavorable, is to be thanked for our comparative immunity from them.

Such being the relation of *Teredo* to man's interests, it is not surprising that great attention and much experiment have been given by practical as well as scientific men to methods of circumventing them. The most carefully conducted and systematic experiments on record are those described by Dr. Von Baumhauer in the first of the works mentioned below. It obviously does not come within the scope, as it certainly is not allowed by the limits of a paper of this character, to describe at length the experiments or the mode of application of the latter. Those practically interested are referred to the three papers below, that by Dr. Von Baumhauer, the very excellent one by Mr. Murphy, and that by J. W. Putnam, which, though it contains some errors of natural history, appears to be sound and complete from a practical standpoint. All of these are easily accessible.

The Commission, of which Dr. Von Baumhauer was a member, experimented with all means proposed to them by inventors and others. Eight different methods of coating wood were tried, including mineral paints, varnishes, poisonous substances, etc., but none of them proved of any value. They tried six methods of impregnating wood with different substances, including some of the very poisonous salts of copper, iron and lead, only one of which proved efficient. The successful one was oil of creosote — a coal-tar product.

This method proved successful when good oil was used, and to-day it is acknowledged by engineers that the only efficacious way to preserve timber permanently from the attacks of the *Teredo* is to thoroughly impregnate it with creosote. The process must be thorough, for partially filled timbers will be destroyed. The mechanics of the process of impregnation are described in the paper by J. W. Putnam, referred to below. It consists in forcing the oil under great pressure into the previously prepared wood. Woods of loose

texture are the best, for they take the oil better. Creosote has the advantage also of preserving timbers not only from *Teredo*, but from other destructive agencies, for it is a good antiseptic.

This method has been tried and found good in our own waters, as the following passage from Mr. Murphy's paper proves. Speaking of Sidney harbor, Cape Breton, he says: "Here the *Teredo* is seemingly as destructive, if not more so, than at any point on our coast, and here, about ten years ago, a coal-loading pier was erected, sufficiently large that three ocean-going steamers could load coal at the same time. The pier runs out into the harbor. It was erected entirely of pine trunks, creosoted in Great Britain, and sent out here. It has most effectively withstood the ravages of the *Teredo*, whilst all other piles in the neighborhood had to be renewed twice." Mr. Murphy points out the desirability of the establishment of a creosoting apparatus in Nova Scotia, and of a careful study of means of overcoming the *Limnoria lignorum*.

There are other methods of protecting marine works from *Teredo* which have their value. A timber completely sheathed with metal is safe; hence copper-bottomed ships are not troubled. Docks and wharves have been sheathed with different metals, but these are efficacious only so long as the surface is unbroken. Accident, the action of the water on the plates, etc., will not, however, as a rule, long permit this. A modification of this method consists in covering the timber with short iron nails having square, flat heads. But these must be placed close together, with their edges touching, and this is very expensive. In the American Naturalist, Vol. XVI. 1882, p. 967, another method is described as follows: "His machinery cuts out a cylinder two inches thick from between the core and the outside of a log, and of any desired caliber. By retaining the core and filling the cylindrical excavation around it with a special cement, it is thought that the ravages of the *Teredo* could be confined to the outer part of a pile so treated, and the core, which is expected to sustain the needed weight, would be protected by the cement, which in its turn would be preserved from friction by the outer

coating of wood and bark." The writer's friend, Mr. K. Miyabe, of Japan, tells him that a countryman of his has invented a method of preventing its ravages. It consists in a process of lacquering. Coatings of barnacles, when numerous and near enough together so that their bases touch, form a protection, but one which it would be difficult to produce artificially. Coatings of the common Mussel (*Mytilus edulis*) have been suggested also; but much the same objection would apply to them, and the coating would be liable to be removed by accident. An annelid preys upon the *Teredo*, but not to an extent sufficient to assist man. Fresh water is one of their greatest enemies, and foul water another. A method of ridding a ship of them which has been suggested is to take her for some time into fresh water; but our ship owners would not be long in seeing objections to this. There seems to be a possibility, however, that under certain circumstances wharves might be protected by being built where fresh water streams empty, or even, in some cases, where foul water, such as comes from chemical works and the like, could be directed against them. The latter remedy, however, would be too likely to become worse than the trouble.

As an offset to all the damage done by the Ship-worms only a single benefit to man has been suggested. They certainly help to remove old wrecks, both floating and sunken, which would be a constant peril to navigation.

WORKS OF REFERENCE.

The *Teredo* and its Depredations. By Dr. E. H. Von Baumbauer [translated from Archives of Holland, Vol. I.] Popular Science Monthly, Vol. XIII., 1878, pp. 400-410, 545-558. Its more important parts are quoted in the following.

On the Ravages of the *Teredo Navalis*, and *Limnoria Lignorum*, on Piles and Submerged Timber in Nova Scotia, and the Means being Adopted in other Countries to Prevent their Attacks. By Martin Murphy. Proc. and Trans. Nova Scotian Inst. Nat. Sci., Vol. V., Part IV., 1882, pp. 357-376.

The Preservation of Timber. By J. W. Putnam. Scientific American Supplement, Vol. X., No. 236, July 10th, 1880, 3762-3763.

Teredo. By J. T. Cunningham. Encyclopædia Britannica, 9th Ed., Vol. XXIII., 1888, pp. 184-186.

The Teredo or Ship-worm. By R. E. C. Stearns. American Naturalist, Vol. XX., 1886, pp. 131-136.

28. *Teredo Norvagica* Spengler.

[*Teredo*, a borer; *Norvagica*, inhabiting Norway.]

Ship-Worm.

DISTRIBUTION. (a) *General*; — Cape Cod northward North European Seas.

(b) *In Acadia*; — "Marine slip timbers at Pictou. (Whiteaves)," *Jones*. Further distribution not known. As stated under *T. navalis*, much or most of the damage attributed to that species may be due to this.

HABITS. In general similar to *Teredo navalis*. It would be extremely difficult for the untrained observer to distinguish them. Specimens should be sent to some special student of Mollusca.

ECONOMICS. Similar to *T. navalis*.

29. *Teredo dilatata* Stimpson.

[*Teredo*, a borer; *dilatata*, swollen.]

DISTRIBUTION. (a) *General*;—South Carolina to Cape Ann. Sable Island.

(b) *In Acadia*;—"Very large specimens have been received from Sable Island, taken from wrecked timbers (Willis)," *Jones*.

[There is a possibility that this species may be the following, but it is unlikely. It is a southern species, but many such occur on Sable Island.]

HABITS. *In general similar to Xylophaga dorsalis*. They probably cannot be distinguished by the untrained observer. This is a small

species, and is nearly as broad as long. It is about half an inch in diameter.

ECONOMICS. Probably similar to *Xylophaga dorsalis*.

30. ***Xylophaga dorsalis*** (Turton) Forbes and Hanley.

[*Xylophaga*, wood-eating; *dorsalis*, from plates on its back.]

[The *Teredo dilatata* of Mr. Whiteaves' first report, as he tells us in his second.]

DISTRIBUTION. (a) *General*; — Northern Atlantic ocean.

(b) *In Acadia*; — New Brunswick and Nova Scotia waters.

Mr. Whiteaves says in his first Report, — "Principal Dawson informs me that great damages have already been done to the woodwork of wharves and harbors in Nova Scotia and New Brunswick, by this species of *Teredo*."

HABITS Though in general structure, habits, etc., it is probably quite like *Teredo navalis*, it differs much in appearance. It is from one inch to one and a half inches long and has the organs more concentrated than in *Teredo*, forming a spherical mass from which a slender tube projects backward bearing the siphons. We find it showing characters intermediate between the *Teredos* and the genus *Pholas*; the latter are shelled bivalves which bore into stone. This species would hardly be distinguished by the beginner from the last.

ECONOMICS. On account of its smaller size, and consequently short burrows, it is not so destructive as the larger *Teredos*, but it nevertheless does much damage both to floating and fixed timber works in Europe.

Mr. Whiteaves says in his first Report, — "Mr. Nelson Davis, of Montreal, tells me that the brigantine 'Magdala,' which was built at St. John, N. B., was completely riddled by this ship-worm some time ago, on her first voyage from St. John to Liverpool. . . . The whole of the ship's bottom had to be renewed and covered with copper sheeting before she was again seaworthy."





